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PETROLEUM REFINER

SPECIALIZED FOR THE OIL REFINING INDUSTRY, INCLUDING PETRO-CHEMICAL ENGINEERING, PETROLEUM SYNTHETICS AND NATURAL GASOLINE

MARCH, 1943
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Editor

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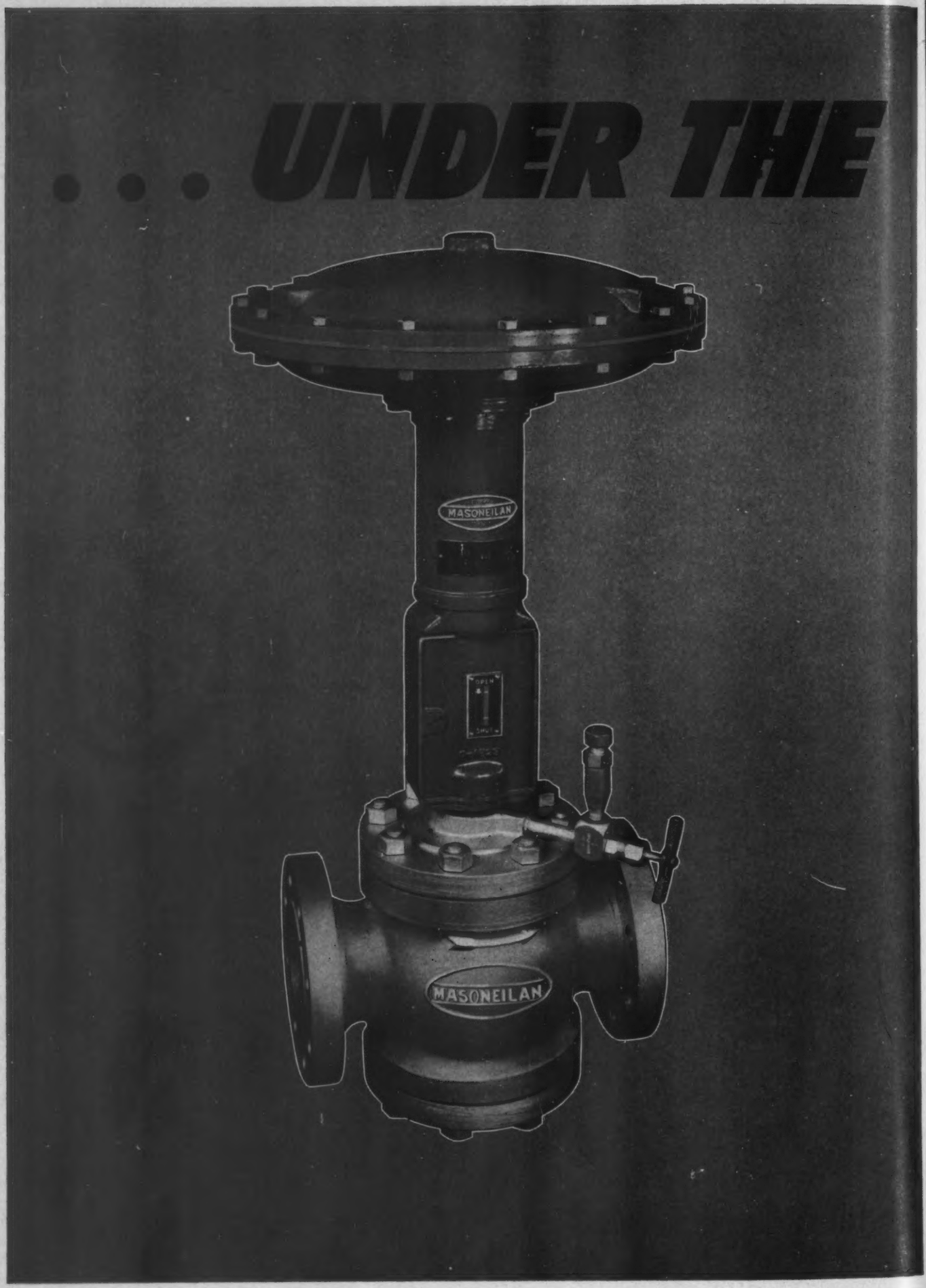
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PETROLEUM
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SPECIALIZED FOR THE OIL REFINING INDUSTRY, INCLUDING PETRO-CHEMICAL ENGINEERING, PETROLEUM SYNTHETICS AND NATURAL GASOLINE

A GULF PUBLISHING COMPANY PUBLICATION

THE LOOK BOX

DETAILS of the plan whereby plant construction for synthetic rubber has been curtailed are more encouraging than the early reports that followed the controversy and subsequent settlement by James M. Byrnes. The details have been given in the report of William M. Jeffers, rubber director, in keeping with requirements of his office.

Status of Rubber

Although only 43.6 percent of the capacity recommended in the Baruch report is now under directive, work is continuing on an additional 34.4 percent. This latter does not presently have the benefit of directives and high priority ratings. The report of the director, however, indicates that work can continue on the additional plants, which will in time be given directives and higher priority ratings.

Thus the whole program stands at 78 percent of the 1,037,000 tons of annual capacity recommended by the committee. The combination of plants under directives and those left to continue construction without this benefit amounts to annual rubber capacity of 813,000 long tons. The part under directives amounts to 452,000 tons, of which 435,000 tons is Buna S rubber.

Primarily the refining industry is concerned with the butadiene program, which stands now at 656,860 tons per year, which includes plants under directives and those left building without benefit of this stimulant. Of this total for butadiene capacity, 436,860 tons will come from petroleum and 220,000 tons from alcohol.

The total from petroleum will be from the following raw materials: from butene by dehydrogenation, 265,100 tons; from butane, 75,000 tons; from naphtha cracking, 96,760 tons. The latter is the refinery conversion program, which was restricted recently by cancellation of five projects.

Of these cancellations the rubber director inserted this in his report:

"Even though experience should prove the canceling of these conversions to have been an unwise move, the demand for component parts should be so much less by early fall that other steps could then be taken which would not delay their share of the program more than a month or two. . . ."

This is encouraging in that it leaves the whole program to keep step with the availability of materials.

Immediate effect of alterations in the synthetic-rubber program will reduce the amount of all rubbers that can be manufactured in 1943. Under the program of the Baruch committee the 1943 total was to have been 354,000 tons. Expected production under the restrictions now imposed will allow production of only 241,000 tons in 1943.

It is regretable that testimony before an investigating committee gets such wide dissemination while the report on a similar subject gets so little repetition. When Jeffers and men of the military services appeared before the committee last month, headlines left the impression that the synthetic-rubber program had been so emasculated that it held little encouragement for other than military use. The report of the director is more encouraging.

In the final analysis synthetic rubber is a pro-

duct about which the public should be well informed. Instead it is poorly informed because of confusion in Washington. This product is a war necessity which offers the promise of intensive development under peace. It can reach these possibilities only if the public appreciates what comes about.

Too many, some of whom are in high positions, already consider synthetic rubber a product which should be abandoned when hostilities cease. This attitude is based on the proposition of returning to natural rubber as a part of world economy.

A wiser policy would be to permit synthetic rubber to come into free competition with natural rubber when hostilities cease. The product that wins on cost and quality will prevail.

Likewise the controversy between agriculture and oil should be left to settlement of like nature. This is no time to consider which is cheaper, butadiene from wheat or butadiene from butane. When the pressure of war is over the raw materials of lower cost should rule.

Then Don't

FALLS are one of the highest individual causes of accidents throughout the entire country each year. In 1941 one-fourth of the total number of fatalities resulted from falls. Many of these falls result from efforts, thoughtless or deliberate, to jump down from an elevated location or across an opening.

"It is hardly fair to consider these as accidents when one realizes that an accident is defined as an unforseen occurrence. When a man jumps from a loading rack to a tank car, instead of using the gangplank or walkway, he must realize what will happen if he slips or does not jump far enough. A man who jumps down from a truck-loading platform should remember that it has been done many times without harm, but the accident files contain many other cases where it resulted in personal disaster in the nature of a serious injury. How much better it is to use the steps provided for access to and from the platform.

"Tank-truck and stake-truck operators should bear this in mind, as many a one has been hurt just because he failed to use the step and running board built in the truck design for a safe ascent or descent. Even jumping down hastily from the running board of a car or truck without first observing whether or not the ground is clear of obstructions has caused many an injury to foot, ankle or leg.

"A good motto to follow as a preventative of this type of accident is 'Look before you leap and then don't leap.'"

—Texaco Safety Digest.

Stay On The Job

LONG ago each refinery yard should have been placarded with information to assure the crews that their work is as essential as that of men and women who are making shells and explosives. Had that been done there would have been less confusion when early February brought orders from Washington that started married men within certain age limits toward enlistment centers. Many of these men did not consider their work essential. Some sought employment in shipyards, which they did consider essential.

Perhaps men should have known better. Perhaps Selective Service officials should have been more discreet in their announcement. Above all the petroleum industry should have striven to convince its personnel that oil for a Diesel engine rates equally with the engine and the ship it drives.

In case men are still doubtful as to the status of refinery work, here is part of a joint announcement by Paul V. McNutt, chairman of the War Manpower Commission, and Harold L. Ickes, Petroleum Administrator for War:

"Oil and natural gas are vital to this war and it does not help to win the war for men who have long been trained and skilled in this industry to leave their present jobs. We wish to emphasize that while planes, tanks and ships fight the battles, they cannot fight without oil to fuel them. The production, refining, transportation and distribution of oil and gas are all necessary.

Freedom Is Not Free

IT is unfortunate that men give scant attention to the relationship of their votes and their jobs. The two are so closely knit together that separation is impossible. Freedom to work never exists where there is not freedom to vote. So long as men vote as they please they will have the privilege of working as they please. To whatever extent freedom over either is restricted, similar restriction will come to the other.

What it all means is that there is as much democracy in a shop as there is in a voting booth. Still men turn their employment status over to organizations, agencies of government or corporations without considering what it means in politics. Usually job control goes in response to higher income, either real or promised.

In time the encroachment on the job will be translated into encroachment in voting. On the other hand when men submit to voting as told, shortly they will be working as told.

It all amounts to the fact that freedom applies to living rather than political status.

Furthermore freedom is not free. It must be earned; then maintained.

A Method by Which Refining Plants May Accumulate Scrap Metals Using Sound Business Principles

G. M. DENT
Materials and Specifications Engineer,
Pan American Refining Corporation

SINCE Pearl Harbor the country has been urged to become scrap-minded, as scrap provides a short-cut to the almost unbelievable quantities of metals required by a nation at war. Scrap metals, like the poor, are with us always. Their quantities and values, however, were not recognized and appreciated by the average citizen until recently when it was pointed out that in the steel industry, the addition of scrap to the charge of pig or basic iron reduces the proportion of impurities, thereby making less refining necessary in the production of iron and steel.

The collection and disposition of scrap metal has long been an honored, active and profitable business. However, even in large industrial plants where replacements and improvements are constantly going on, and where scrap metal is continually accumulating, systematic methods for its salvage, classification and disposal are frequently neglected. In normal times this neglect of so important an item evidenced poor and inefficient business methods. At present, such action is little short of criminal.

The amount of scrap metal produced by the effort of the housewife, school child and the occasional individual doubtlessly has been a substantial contribution to the war effort. But it is not to these sources that the country can look for its supply of scrap metal, as these sources are limited and quickly exhausted. It is from the large industrial concerns of the country that a constant flow of scrap metal must come.

The fact that during the current scrap-metal drive many of the large industrial plants have produced quantities of scrap far in excess of the amounts disposed of regularly prior thereto, indicates the absence of a business-like method of handling this important item.

Economics of Salvage

The company with which the writer is connected has long recognized the need and value of preserving, classifying, and disposing of scrap metal as part of an efficiently-operated business.

The headquarters for scrap is the salvage yard, or reclamation division of the storehouse. Such a yard requires only a small staff, as its principal purpose is to serve as a classifying and clearing house for material to be salvaged and scrapped. The physical layout of the salvage yard is shown in Figure 1.

A proper functioning salvage yard results in con-

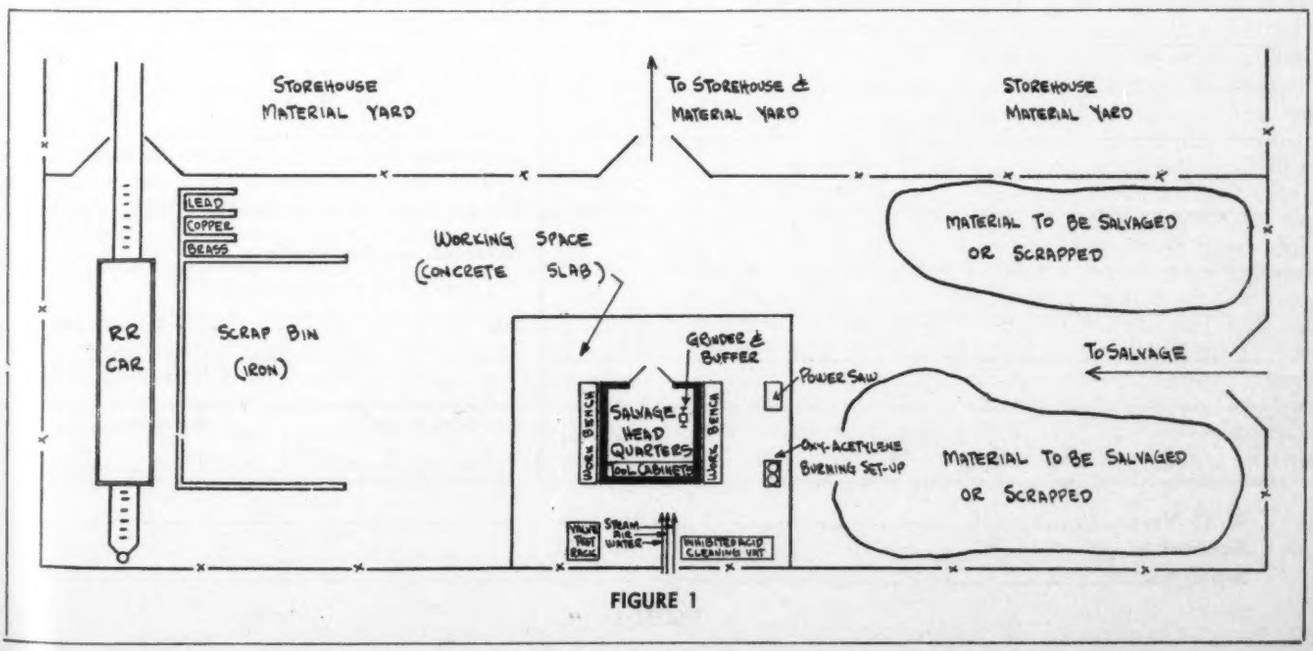


FIGURE 1

siderable economies, and it is principally through the operation of this yard that scrap moves steadily and swiftly to the scrap bins. Therefore, the following deals with the operations of the salvage yard, and as this article concerns the accumulation of scrap, emphasis is not placed on the obvious advantage of preserving and reclaiming critical materials especially during the present national emergency.

After the field forces have completed a job and have delivered to the salvage yard all salvable material recovered from repairs, dismantlings or alterations, their work on the particular job is done. The left-over materials are then the responsibility of the salvage yard.

To install in the salvage yard the necessary machine tools and personnel to reclaim salvaged materials would entail an extensive layout which could not be justified even in normal times, as this would only duplicate existing plant shop facilities. Therefore, the salvage yard is equipped only to take apart, clean, and superficially repair equipment (this being all that is required in a great many cases) and execute the necessary forms in connection with making disposition of the materials.

All material, salvable or scrap, is tallied by the salvage yard, scrap by the estimated total weight of each delivery and the salvage material by item. For this purpose a form of tally is used as shown in Figure 2. Where feasible a durable tag is affixed to the material to identify it with the tally number. As material is delivered to the salvage yard, or as soon thereafter as practicable, it is sorted and inspected and the cost of reconditioning estimated. It is difficult to arrive at a satisfactory estimate of the cost of reconditioning certain types of material without taking apart and thoroughly inspecting; however, discrepancies resulting from cursory inspection are compensating to a great extent and are warranted by the fact that a speedier application of credits will be permitted to the various jobs from which the materials are removed.

Keeping the Records

Tallies are written in triplicate as the sorting and inspection proceeds. Only one item is listed on each tally, but the quantity of each item reported is not limited. The description placed on the tally is as complete as possible in order to facilitate identification with the storehouse records. The date, quantity and percent of original value is filled in under the heading "received into salvage." The work-order number of the job from which the material was removed is inserted in the space provided for this purpose. The "original value" column is left blank, as this is filled in by the cost accounting department. The tally is signed by the salvage yard foreman and the original sent to the cost-accounting department, duplicate and triplicate being retained at the salvage yard. On the basis of information appearing on the original, the accounting department determines the amount of credit and makes monthly booking, crediting the jobs indicated by the work-order numbers and charging the salvage-materials account.

Material unfit for further use is moved directly to the scrap bins. Salvage tallies are written for all larger scrap receipts but no effort is made to record the smaller receipts as the labor required is not justified. Therefore, an accurate recording of the scrap on hand at all times is not available, but this procedure reduces the amount of accounting-department adjustments necessary at the time of bulk sales of scrap. The duplicate tallies on scrap are prepared and

SALVAGE TALLY No._____

DESCRIPTION	ORIGINAL VALUE	QUANTITY	PERCENT OF ORIG. VALUE	AMOUNT
		Received into Salvage		19
		Salvage Yard		Accounting Dept.
		Received into Storehouse		19
		Salvage Yard		Storehouse

W. O. No._____ Remarks: _____

Account or
Serial No._____

FIGURE 2

filed separately at the salvage yard until an accumulation of scrap is sold when they are forwarded to the accounting department with notification of sale.

Materials that can be repaired and for which there is further use are sent to the machine, boiler, welding and instrument shops for reconditioning, which serves as fill-in work during slack periods. The salvage yard keeps a record of these items by removing duplicate tallies from tally books and filing separately, noting the shop on the tally. (Scrap bins are maintained at each shop into which workers are instructed to deposit all metal which is deemed unfit for use.) When reconditioning is complete the salvage-yard foreman arranges for delivery to the storehouse or return to the salvage yard as required.

Material which requires superficial repairing, cleaning, and painting is processed at the salvage yard before being turned over to the storehouse for reissue.

When material has been reconditioned and is ready to be sent to the storehouse, the section "received into storehouse" on the duplicate and triplicate copies of the corresponding tallies are filled into for date, quantity and percentage of original value, signed at the salvage yard and the duplicate copies are forwarded with the material to the storehouse. The storehouse receiving clerk signs as acknowledgment of receipt of materials, makes any necessary alterations in description and forwards duplicates to the accounting department where they are completed for amount, and where monthly booking is made, charging the storehouse account and crediting the salvage materials account.

A physical inventory of salvage is taken at least each calendar quarter and more often if it appears advisable. This is done by listing tally numbers appearing on the tags of the materials in salvage. Description and quantity on the inventory form is provided by the accounting department. The inventory includes all salvage materials at the shops for reconditioning and an estimated weight for each type of scrap on hand as well as materials actually in the salvage yard. The original is signed by the salvage-yard foreman and sent to the accounting department for its use in verifying the amount set up in the salvage account.

If possible, issues of material directly from the salvage yard to jobs are avoided, but if such issues are made, the duplicate and triplicate tallies are filled out the same as for material sent to the storehouse, signed by the salvage-yard man and receipted by the individual receiving the material. Under "remarks," a brief comment and the work order number to be charged are shown, and the duplicate copy of the tally is forwarded directly to the accounting department for use in posting the accounts.

Determining Values

Estimates of the value of materials taken into the salvage yard are based on the percentage of probable stores valuation which will be assigned to the material on completion of reconditioning. An arbitrary standard "percentage of original value" of 80 percent for all reconditional material delivered into stock is used, with the following exceptions:

a. New material broken or damaged during installation and sent to the salvage yard for repair is returned to stock at 100 percent of original value.

b. Pipe and fittings under 2 inches in size and bolts and nuts and similar small material are returned to stock at 100 percent of new value.

c. Materials which cannot be reconditioned to meet specifications of the service for which they were originally purchased and used, but can be substituted in other services the requirements of which are not so exacting, are returned to stock at 80 percent of the original value of materials for which they can be substituted when reconditioned and not at 80 percent of their own original value. Examples are furnace tubes which are removed due to the walls having reached the minimum thickness allowed for furnaces, but which can be used further as a substitute for standard pipe; or 150-pound steel valves which can be reconditioned for 125-pound cast-iron service but are not suitable for further use in services where 150-pound steel is required.

Having established the probable value at which the reconditioned item will be taken into storehouse stock, the calculation of value when received into salvage is arrived at as shown in the following example:

Original or stock value		$100.00
80 percent of original value		$ 80.00
Deduct: Estimated repair labor	$15.00	
Estimated repair parts	15.00	
Estimated overhead on labor and material	7.50	
		37.50
Estimated present value		$ 42.50
Percentage of original value to be used, percent		40%

Percentages are reduced or increased to the nearest multiple of 5.

If, in the process of reconditioning, any items are found to be in such poor condition that reconditioning is impracticable or uneconomical, they are scrapped except for such usable parts as can be put into shape for storehouse stock. If no parts are salvable the duplicate tally covering this item is noted "scrapped" and forwarded to the accounting department. If usable parts are recovered, suitable notation is made on the copies of the tally in possession of the salvage yard and the duplicate accompanies the parts when sent into stock. Adjustment is made by the accounting department when the duplicate is received.

The above discussion of the functions of the salvage yard explains how scrap automatically finds its way to the scrap bins. The scrap is regularly sold to reputable junk dealers. As a result of this long-established method of handling salvaged materials, our records show that we have not been able to produce the enormous amount of scrap metal under the current drive as in the instance of many of our competitors of comparable size and business, but our records will reflect that we have disposed of substantial quantities of scrap for years as a regular business operation. We find this to be in accord with good business practice, that it saves space, adds to the appearance of our plant and produces worthwhile revenue.

Seal-Oil Systems for Refinery Centrifugal Pumps

IRVING TAYLOR, The Lummus Company

Synopsis

DURING the last few years many centrifugal pumps have been installed in this country which incorporate in their packing boxes some type of mechanical seal, either in place of or in conjunction with the conventional rings of packing. It has been found by several of the oil-refining companies, the refinery contractors, and the larger pump manufacturers that the selection and arrangement of auxiliary equipment needed for lubrication and cooling of these mechanical seals, as well as for lubrication of pump packing, often requires much more engineering than was expected. Although seal applications now are becoming better known to many of these concerns, there would seem to be need for clarification and discussion of the problems which have arisen in this somewhat specialized field.

In this article it is not attempted to mention all the different seals and types of seal-oil systems which have been tried out in refineries. However, it is the object to review the various methods whereby an individual pump is sealed, and to discuss briefly the ways in which problems are being overcome.

IF a seal is defined as an instrumentality for keeping something closed, confined, or in this case leakproof, then one might be literally correct in saying that a pump is sealed mechanically by the compressible material (packing) which is usually arranged to prevent the liquid in the pump from escaping to the outside. But a pump "packed" and sealed in this manner is not considered as having mechanical seals. So we must distinguish the "mechanical" seal from other familiar types of seals such as the water seal, mercury seal, grease seal or a packed stuffing-box. By the term "mechanical seal" we refer strictly to a device through which leakage is prevented by the juxtaposition of hard machined parts, rather than by the compression of some softer intermedial substance in the space where the fluid would escape.

In a centrifugal pump the principal parts of a mechanical seal are the two ring-shaped seal faces which both encircle the shaft side by side, as two rings on a finger. When the pump is running, one ring is rotated by the shaft against the other which is stationary; a construction somewhat similar to a single-collar thrust bearing, but without appreciable thrust. These rings or collars and other parts are so positioned in the packing box that the only possibility of liquid escaping through the box would be by a separation of the seal faces. But this must not happen, so the two rubbing seal-face surfaces are constantly held together; sometimes by hydraulic pressure, sometimes by a coil spring or a set of small springs arranged to press one of the rings against the other axially. Springs are used to prevent the formation of any gap between the seal faces while the pump is stopped, and to help prevent separation which might occur due to end-play or whipping of the shaft while running. In some cases the springs rotate with the shaft, holding the rotating collar axially against the stationary collar. (The latter often serves also as the pump-throat bushing or as the packing-box gland). In other instances, stationary springs may press the non-rotating collar against the rotating one which is locked on the shaft. In either case there must be provision for a slight amount of axial sliding of one of the seal-ring collars to maintain the closure constantly. To prevent any liquid from leaking past the seal through this joint of sliding, it is the practice to arrange the sliding member with a single ring of rubber or neoprene, or sometimes a metal "piston ring", to act as a flexible gasket.

The "faces" of the seal rings must be hard and smooth, and in proper alignment. Often the rotating seal ring is faced with stellite. Bronze makes the best material for the stationary face, except for installations where no lubrication is provided either by the liquid in the pump, or from the outside. In these cases stationary seal faces of carbon have been found satisfactory, although their life is not as long as that of the lubricated bronze seal rings.

Whether a refinery pump is equipped with packing or with mechanical seals, lubrication in some form is usually required for the contents of the packing boxes. The lubricant usually is called "seal oil", and is used instead of water or grease except where these mediums may be more suitable. This lubricating "seal oil", as referred to henceforth, is of course not to be confused with an oil obtained from the marine animal, the seal.

Sealing Arrangements Used

The following is a list of the various sealing methods frequently used for centrifugal pumps in refinery services:

1. Several compressible packing rings, divided into two sections by a lantern ring (sometimes called a waterseal cage) which permits introduction of a lubricant near the center of the packing space. (Figure 1).
2. Compressible packing rings and lantern ring, the same as arrangement No. 1, plus a special connection to a labyrinth-type throat bushing or pressure-reducing device at the inner end of the box, to permit either:
   (a) *Bleeding out* a small amount of liquid from the pump to a lower pressure (to reduce pressure on the packing rings), or
   (b) *Injection* of a different liquid from the outside (so that packing rings will not be subjected to the liquid being pumped). (Figure 2).

3. Single mechanical seal, usually having the rotating unit inside the box and surrounded by the liquid being pumped; sometimes arranged with a groove in the stationary-seal face for introduction of a lubricant to the seal faces only. (Figure 3).
4. Double mechanical seal, with both rotating units inside the box surrounded by a lubricating seal oil; the seal oil maintained at a pressure slightly higher than the internal pump pressure which acts at the packing-box throat bushing. (Figure 4).

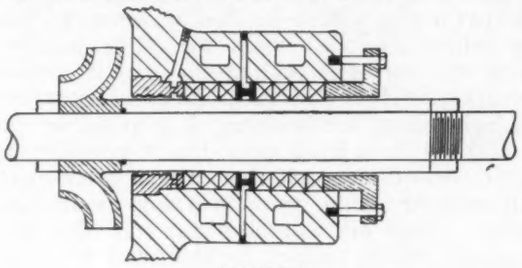


FIGURE 1
Packing box with lantern ring

Method No. 1 can generally be employed successfully for pumping services wherein the liquid being pumped is not lighter than about 0.60 specific gravity, and not corrosive or injurious to packing. It is well suited for hot-oil pumps since the packing is kept from overheating where it rubs on the shaft, because the lubricant works its way in between the packing rings and the shaft in both directions from the lantern ring. As in the packing boxes of most reciprocating pumps, a few drops of lubricant can be "dead-ended" to the lantern rings of centrifugal pumps at each stroke of an ordinary plunger-type mechanical lubricator, but more often the lubricant is "circulated through" their lantern rings. Here there must be two connections to each lantern ring —one as the seal oil inlet, and the other as the outlet.

Circulating the oil through the lantern rings instead of merely dead-ending it to them will cool the

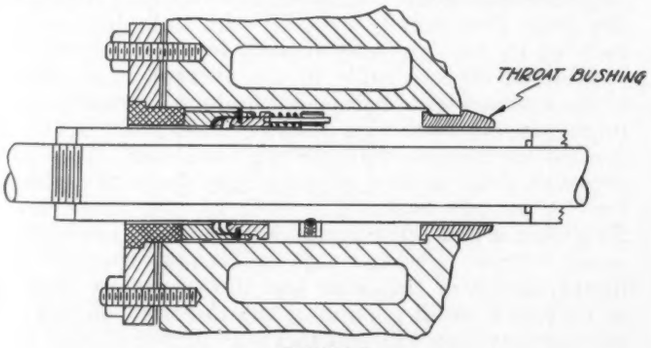


FIGURE 3
A single mechanical seal

packing directly, and will improve its service factor beyond that obtained if cooling is only accomplished by water-jacketing. Furthermore, operators can observe more definitely that the oil actually gets to each lantern ring (by sight flow gauges or instruments) than if dead-ending is arranged. The seal oil itself may be a gas oil, a heavy naphtha, or a lube oil, and can either be circulated by a separate pump or be taken directly from a process line as a sidestream, distributed through the lantern rings, and returned into some other process line or vessel.

The question as to whether the seal-oil pressure at a lantern ring should be slightly higher than the pump's internal pressure, or lower, is one of conjecture, but it is not a very vital issue. Those who favor the slightly higher pressure believe that a small amount of seal oil should always be bleeding into the pump, especially if the circulation system is separate from the process. Others feel that such a situation also produces excessive leakage of seal oil out of the ends of the packing boxes, so that they advocate a seal-oil pressure not to exceed approximately 60 psi regardless of the pump-suction pressure. The latter setup is more simple, and still fulfills the purpose of

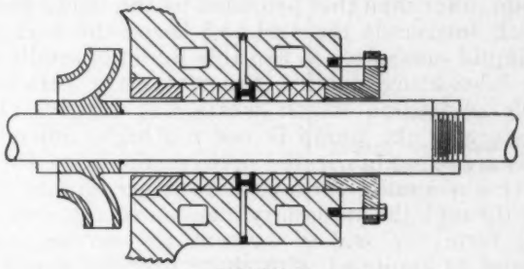


FIGURE 2
Packing box with lantern ring and connection at inner end for either bleed out or injection.

providing satisfactory lubrication for the packing, even if a small amount of the pumped liquid does bleed into the seal oil.

When the packing problem becomes too difficult to solve with the first method, perhaps due to a combination of very light liquid and high pressure, any of the other packing-box arrangements is possible. The choice among these is dependent on the type of refinery process involved, the pump manufacturer selected, how close together the pumps will be, and the maximum pumping temperature expected.

For instance, bleeding out a few gallons per minute through a pressure-reducing bushing and connection at the inner end of the box is an excellent way of eliminating high pressure on the packing, **provided** that there is available in the plant a vessel at low

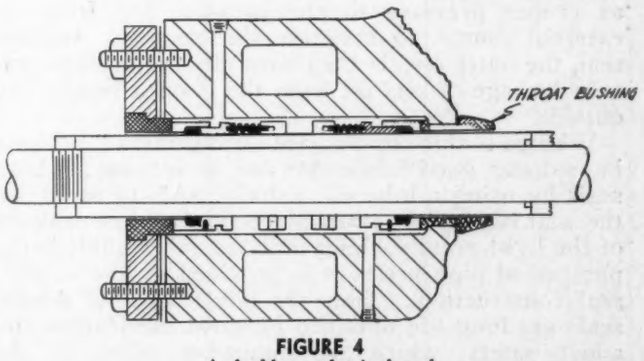


FIGURE 4
A double mechanical seal

pressure to receive the "bleed-off". Quite likely much of the liquid will change to gas (or steam) on having its pressure reduced, so this method should not be chosen without due consideration.

Likewise, injection of a heavier liquid through a similar connection and bushing at the bottom of the box can solve a packing problem wherein the liquid being pumped is very light gravity or injurious to packing. But in this case there will be a slight contamination of the liquid handled by the pump, which sometimes precludes the injection method.

If mechanical seals are chosen, the single seal

would appear preferable to a double seal from a standpoint of cost and simplicity. But as yet not many manufacturers have developed a good single mechanical seal suitable for continuous duty in application involving high pressure or lack of lubrication. For this reason the double mechanical seal has most often been selected. Since the double-seal application has certain definite limitations, to be discussed presently, it is hoped that single seals will shortly be developed to such a stage that they can be applied with confidence.

The best single mechanical seals require no lubrication other than that provided by the liquid pumped, which surrounds the seal and keeps the seal closed by liquid pressure. When this liquid is totally without lubricating quality, the stationary seal face is made of carbon which wears but slowly. If the pressure in the pump is not too high, other single seals are being lubricated between the faces, by introduction of grease (or a few drops per minute of lube oil) through the stationary member to a groove in the seal face. A seal-oil system for serving several pumps all equipped with these grooved single seals need only consist of a multi-feed power-driven mechanical lubricator with each feed piped to one single seal.

Often the outer stationary member of a single seal is arranged with a very small auxiliary packing-box on the outside, containing two or three rings of very small size packing. Between this packing and the stationary seal face is a chamber to collect any possible leakage from the single seal, for connection to the vent line or flare. This arrangement merely prevents filling the pump room with gas, and is not intended to withstand any amount of pressure.

Double Seals

Double mechanical seals, with both units inside the packing box facing in opposite directions, have proven to be a satisfactory means of solving many difficult packing problems. The inner seal tends to be opened by the pressure of liquid within the pump with this arrangement, so a seal oil must be supplied at proper pressure to the packing box from an external source, to maintain the closure. Another seal, the outer one, is then naturally required to prevent leakage of seal oil from the flooded box to the outside.

Why go to this complicated arrangement? Because in so doing, good lubrication can be secured for both seals by using a lube oil (usually SAE-10 or 20) as the seal oil. Also, extra protection against leakage of the light-gravity highly inflammable liquids being pumped at high pressure is provided by the double-seal construction. Thus the advantages of double seals are long life obtained by good lubrication and added safety, which are somewhat offset by the necessary evil embodied in the large amount of seal-oil-system equipment required. Double seals have not performed very satisfactorily in high-temperature services or on large high-pressure multi-stage pumps having Kingsbury type thrust bearings. Perhaps this was due to a greater amount of end-play being permitted by the Kingsbury bearing than by a ball-type thrust.

Experience has shown that seal-oil systems which are installed to serve a group of centrifugal pumps having double mechanical seals are more complicated than those systems in general use for providing lubrication to a group of pumps equipped only with packing and lantern rings. This is primarily due to the fact that most of the mechanical seals in use today depend on the pressure of the seal oil which lubricates them for maintaining the closure. (The springs serve to keep the seals closed while the plant is not running). Therefore, the seal-oil pressure at each operating pump must always exceed the pump-suction pressure, or the pressure existing at the packing-box throat, by a safe margin, usually 25 to 50 pounds.

If the seal-oil pressure should fall below the throat-bushing pressure, even for a moment, the inner seal will "open", i.e., the force of the seal oil and the springs which keep the seal closed will be overcome, such that a gap will be formed between the two seal faces when the one which can slide moves back against the springs. When the gap is formed the lubricating seal oil will temporarily be contaminated with light ends; furthermore, it is possible that the seal will not close itself upon the re-establishment of greater seal-oil pressure, because of sticking of the small neoprene ring or piston ring mentioned previously. Then oil will pour through the gap into the pump, which cannot be tolerated for long. So the pump must be shut down due to a combined deficiency of the seal and failure of the seal-oil system. It can be seen that considerably more engineering will be involved in setting up a seal-oil system with controls for assuring that seal-oil pressure on each of several different pumps be kept constantly in excess of their different and variable throat-bushing pressures, than in arranging for a fixed pressure throughout the system.

A question which will immediately be prompted is, "How much seal oil will get through into the pump by working between the faces of the inner mechanical seal, due to the pressure of the seal oil being slightly higher than the pump-suction pressure?" The answer is, from practically nil to two quarts per 24 hours, after the first few days of operation. During this initial period the seals are "wearing in", and are consequently prone to temporary excessive leakage due to minor inaccuracies in the installation of the stationary seal rings. But the probable maximum contamination of one gallon per day from then on (by a pump with a double seal in each of its two packing boxes) is not likely to be considered objectionable in the average case. Few of the streams will be finished products anyway. One might expect to find a greater leakage of seal oil toward the outside through the outer seal, since the pressure drop across its face may be many times the 25 pounds across the face of the inner seal. However, a greater leakage outward does not necessarily result. Perhaps this is because there is no liquid outside of the outer seal to continually absorb or entrain a small portion of the thin film of seal oil existing between the seal faces, as there is inside the inner seal.

Multiple Installations

Seal oil for double seals is seldom dead-ended to the packing boxes because the opportunity for a certain amount of direct cooling of the seals is thereby lost.

In operation, care must be taken that the external seal-oil pump (a gear- or screw-type rotary) is always started long enough before the centrifugals which are being sealed to insure steady air-free flow, and left running until after the centrifugals have been stopped.

Having reviewed the different methods of arranging a packing box to seal properly under difficulties

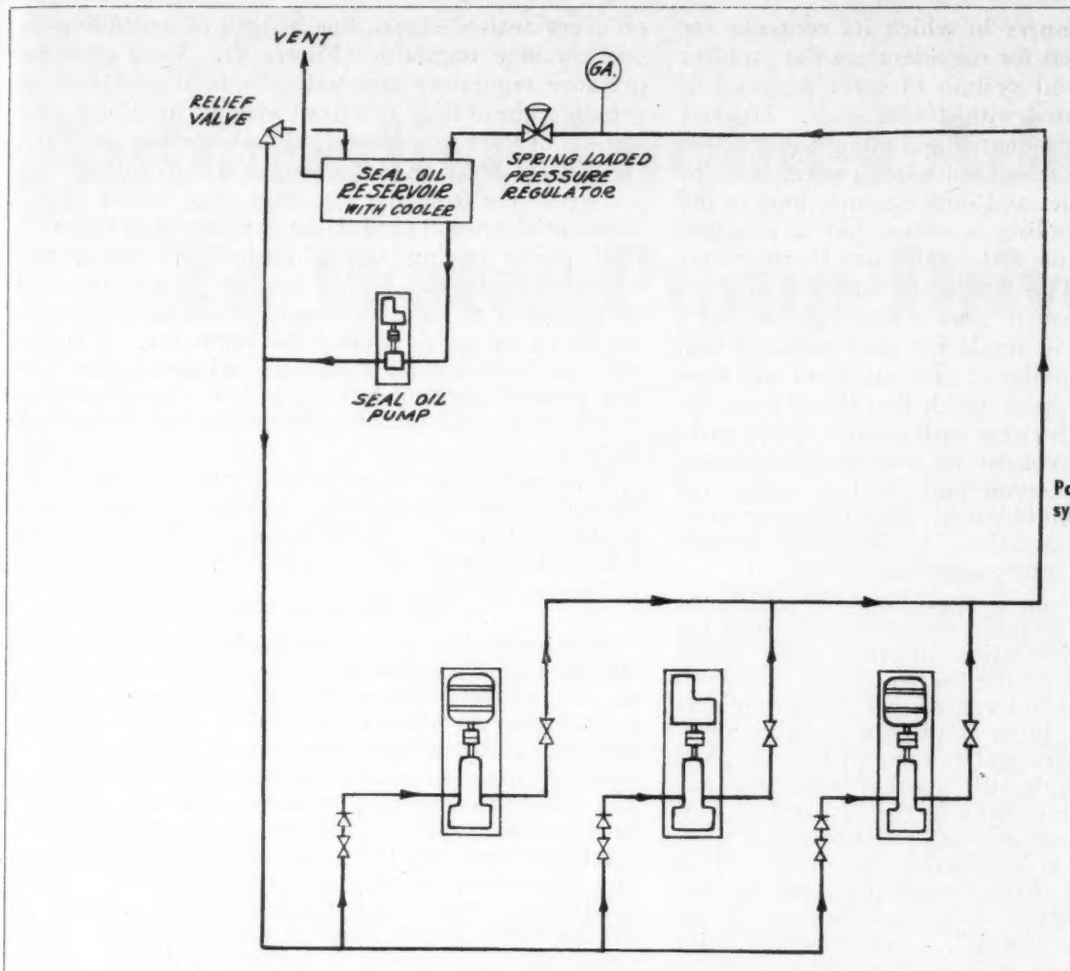


FIGURE 5

Parallel circuit seal oil system dependent on one regulator.

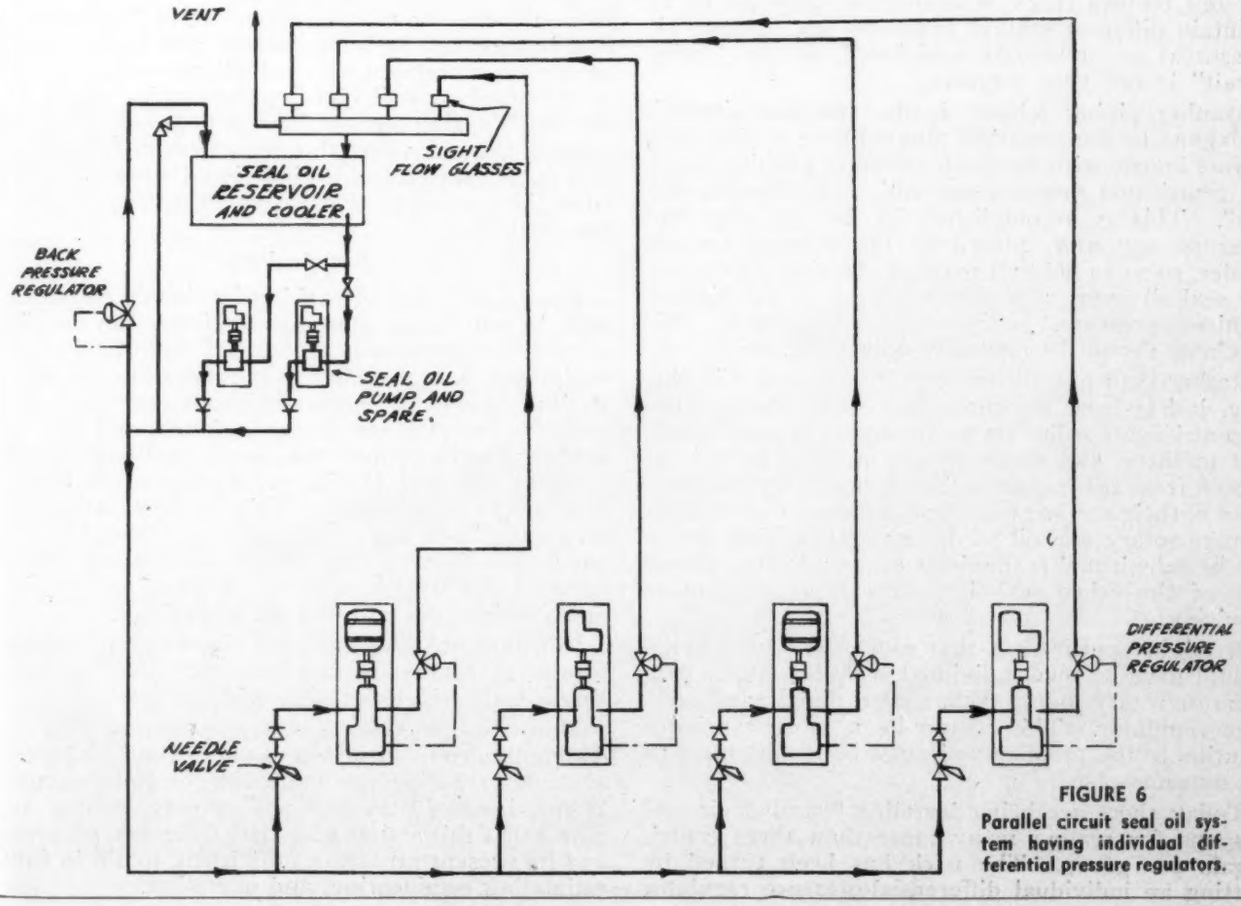


FIGURE 6

Parallel circuit seal oil system having individual differential pressure regulators.

and the various manners in which its contents are lubricated, there is left for consideration the problem of arranging a seal-oil system to serve a group of several pumps all fitted with double seals. To start with, assume that each centrifugal pump to be sealed will be furnished with seal-oil-piping manifolds for connection to the inlet and outlet connections of the packing boxes, including a valve and a pressure gauge on the inlet side, and a valve and thermometer on the outlet side. This piping should not often have to be larger than ¾-inch, since a flow of less than 2 gallons per minute is ample for each packing box. The main inlet and outlet of each manifold will then be connected to the lines which branch off from the seal-oil-system headers near each pump. Other parts of the system will consist of a seal-oil-circulating pump and driver, reservoir tank, seal-oil cooler, (or perhaps several of these parts), plus strainers, pressure regulators, check valves, block valves, gauges, relief valve and the interconnecting piping.

There are about four general ways in which the seal-oil headers can be piped up so as to serve all the pumps requiring circulation through their boxes. One of these would be the "series circuit", wherein the seal oil goes first to a centrifugal pump requiring high pressure, from there through a pressure regulator to another centrifugal at reduced pressure, and perhaps even through still another regulator and centrifugal before it returns to the reservoir. This type of system has not proven to be successful when applied to double-seal installation due to the critical pressure limitations of these seals and resulting contaminations, particularly during starting-up periods before getting "on stream". And for circulation through lantern rings, it is usually unnecessary to maintain different seal-oil pressures (or "gland" oil pressures) as previously mentioned, so the "series circuit" is not very popular.

Another piping scheme is the "parallel circuit", analagous to the electrical single-phase wiring in a private house, with the same pressure existing in all the centrifugal pump boxes which are "across-the-line". This is accomplished by having only one pressure regulator, placed in the common return header, so as to hold all parts of the circuit between the seal-oil pump and the regulator at the highest required pressure. (Figure 5). Of course, this regulator should be manually adjustable.

Rather than put all the eggs in one basket in this way, it has been the practice to limit the number of centrifugals being sealed in any such parallel circuit to three, and these groups of three have been chosen from the complete list of pumps by consideration of their services and suction pressures. Usually a spare rotary seal-oil pump is also provided, which can be substituted (sometimes automatically) should any of the other seal-oil pumps falter or require servicing.

It might appear then that each centrifugal pump should have its own individual seal-oil system, with separate rotary pump, tank, cooler, piping, and pressure regulator. This would be a most expensive solution to the problem and must be looked upon as the extreme case.

Today there are being installed "parallel circuit" systems for sealing many more than three centrifugals per group. The trick has been turned by putting an individual differential-pressure regulator on every seal-oil-return line instead of depending on one common regulator (Figure 6). Each of these pressure regulators automatically maintains seal-oil pressure ahead of it at a fixed amount in excess (say 50 psi.) of the corresponding throat-bushing pressure, regardless of variations in the latter. By connecting a control line from the top diaphragm casing of the differential-pressure regulator to a part of the centrifugal pump having throat bushing pressure, and adding a spring on top of the diaphragm to exert 50 psi., then the seal-oil pressure will have to be in excess by 50 psi. to balance the regulator. A needle valve or fixed ordifice should be included in the inlet line to each packing box, to permit the differential regulator to spill rapidly when reducing the seal-oil pressure.

In general it is advisable to drive the rotary seal-oil pumps with steam turbines rather than motors, to guard against even momentary losses of pressure which might occur due to power failures.

Oil Pressure Units

The increasing use of mechanical seals requiring circulation of cooled seal oil has brought about the development of a small seal-oil system in unified form, called an "oil-pressure unit". By the combining, on a lightweight base, of a 30-40-gallon oil reservoir together with a small rotary seal-oil pump and driver, as well as a cooler (which may be built into the reservoir), a pressure gauge, an adjustable black-pressure regulator, an oil-level gauge glass, and convenient piping connections, all the elements needed are brought conveniently together. This uit can be placed in the pump house fairly close to the pump or small group of pumps which it serves, without need for a foundation. It is "portable" in that it need not be bolted down, and it can readily be moved or replaced with a duplicate unit as quickly as the small seal-oil pipes, water-cooling pipes, and electrical wiring connections can be changed. If desired, the one adjustable regulator built on to the unit could be replaced by individual automatic regulators in the return lines so as to make the system more reliable.

Conclusions

The replacement of packing by double mechanical seals in centrifugal pumps necessitates the purchase of such a considerable amount of additional special equipment that a refiner might question the advisability. However, mechanical seals that have given very fine service for three or four years are still running and have operated almost continuously with a leakage of only ¼ pint per 24 hours per packing box, after "wearing-in". This is very satisfactory progress, justifying their use and showing that much has been accomplished toward eliminating some of the trouble, expense, hazard, and unsightliness which goes with the use of packing.

It would behoove the centrifugal-pump manufacturers, or others, to continue the development of single seals which function without seal oil.

Many of the refiners and contractors have undoubtedly been surprised to discover that seal-oil systems were somehow overlooked or underestimated at the times of planning new refinery plants. It is hoped that this article may clarify the seal-oil system and its present problems sufficiently to aid in future estimating, engineering, and operation.

Automotive Engines Adapted To Water Pump Drives

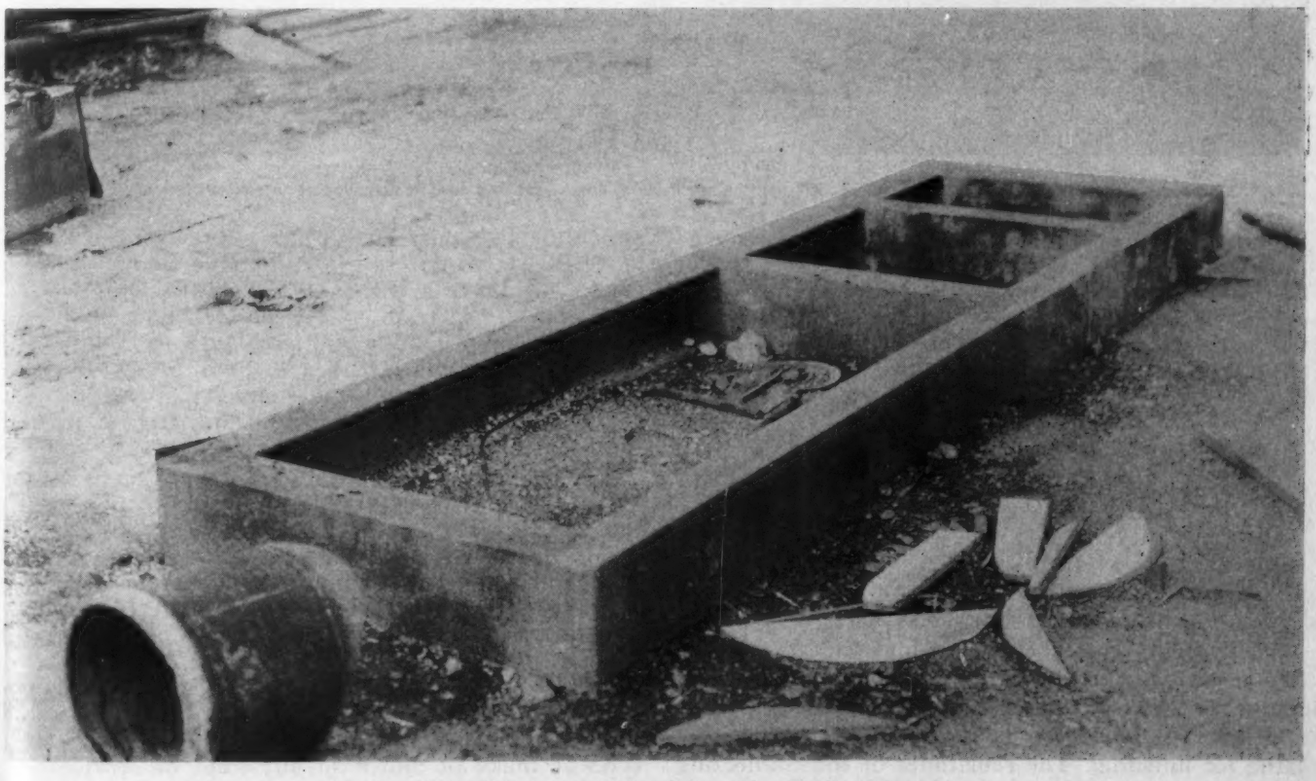
WHEN the overall output of a California natural-gasoline plant was increased early this year, the need for additional engines for the added cooling-tower water came into conflict with the required priority requirements. Efforts to get added pump capacity led to the conversion of used truck and bus motors to stationary service.

The engines selected were all of the same general type, although no two are identical. They were designed to operate on middle-grade gasoline in the heavy service common to city and inter-city service. Their removable sleeve design permitted reconditioning so they would deliver power at reasonable speeds and under constant load and jacket temperature.

Converting them to stationary use required ingenuity of design to assure proper suspension and adaptation to sub-base mountings. In the absence of bases commonly furnished with commercial pump drives, it was decided to fabricate structural steel bases, each designed for its individual engine. Wide channel steel was selected and made into rectangles, having cross members for the rear of the engine and for the pump base. The bases were made with the channel inside with mitre-cut joints and completed by welding.

Lining Up

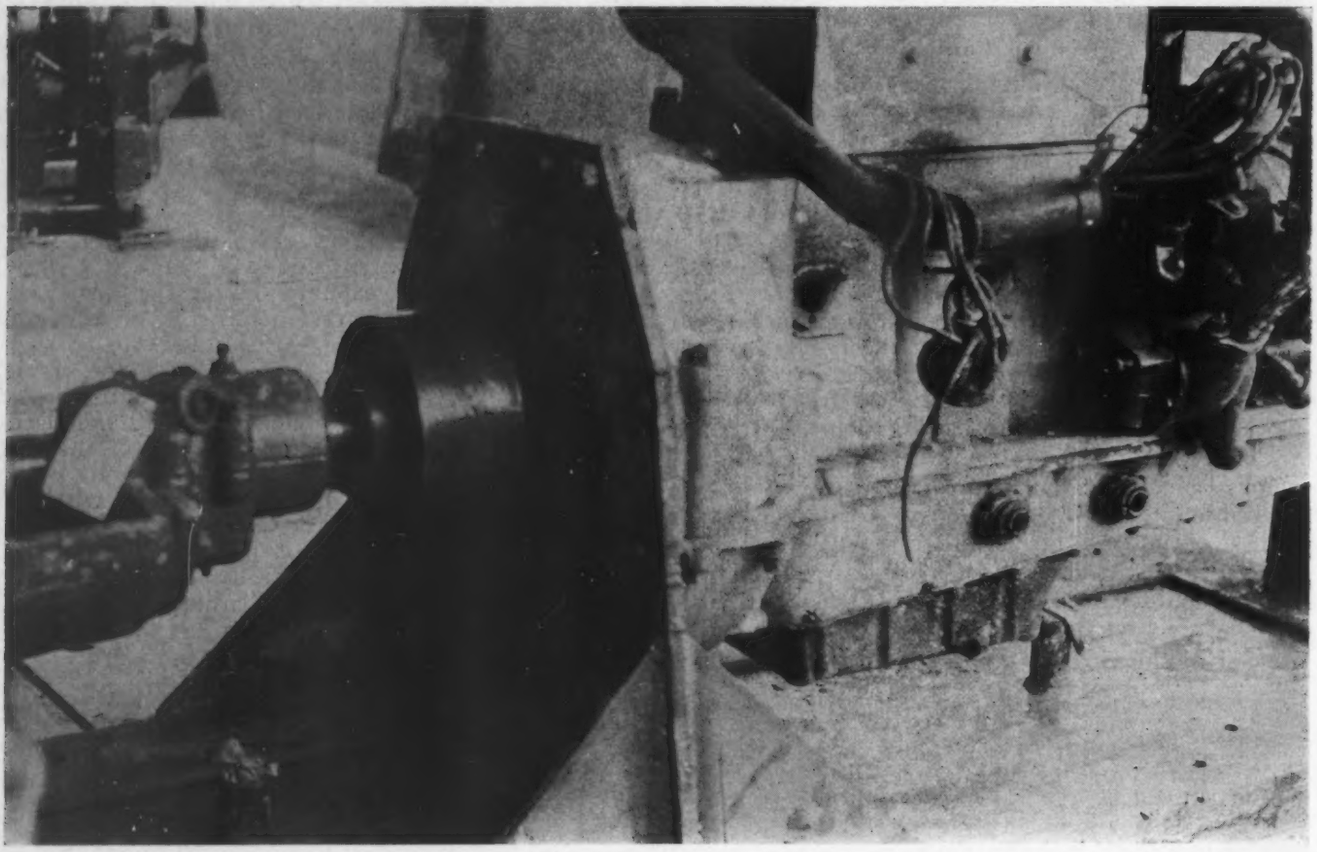
Mounting these engines upon the channel iron bases required a different design for each, but since each one was to drive pumps of identical size and manufacture, the distance from the lower edge of the fly-wheel bell housing varied somewhat so that exact alignment might be made between the crank shaft of the engine and the impeller shaft of the centrifugal pump. Heavy boiler plate steel was used for the supporting member for the rear of the engines, some units requiring that the supporting plate cover the entire bell housing. One motor with an octagonal shaped bell housing rim was fitted with a plate with holes bored to match the clutch housing capscrew tapped holes and the dowel pins for centering. This plate was cut with a circular hole slightly smaller in diameter than the opening of the fly-wheel



An all-welded sub base was designed for each reconditioned engine

bell housing to provide access to the coupling between the pump and the engine. This plate extends downward to the sub-base cross-member and is welded solidly to that unit. The length or height of this supporting plate, obviously, is sufficient to line up exactly the crankshaft of the engine with the impeller shaft of the pump.

Gussets are welded on both sides of the vertical supporting member, cut as a triangle by splitting a square sheet of steel diagonally to save metal. The front end of the motor, originally suspended in the chassis of the motor vehicle by a cap-covered bearing, is held in place by a vertical section of channel iron trimmed to shape and welded to the cross member of the channel-iron base. It is shaped as a saddle at the top to receive the front of the timing chain cover which extends away from the motor and provides enough room for the purpose between the cover and the fan belt sheave.



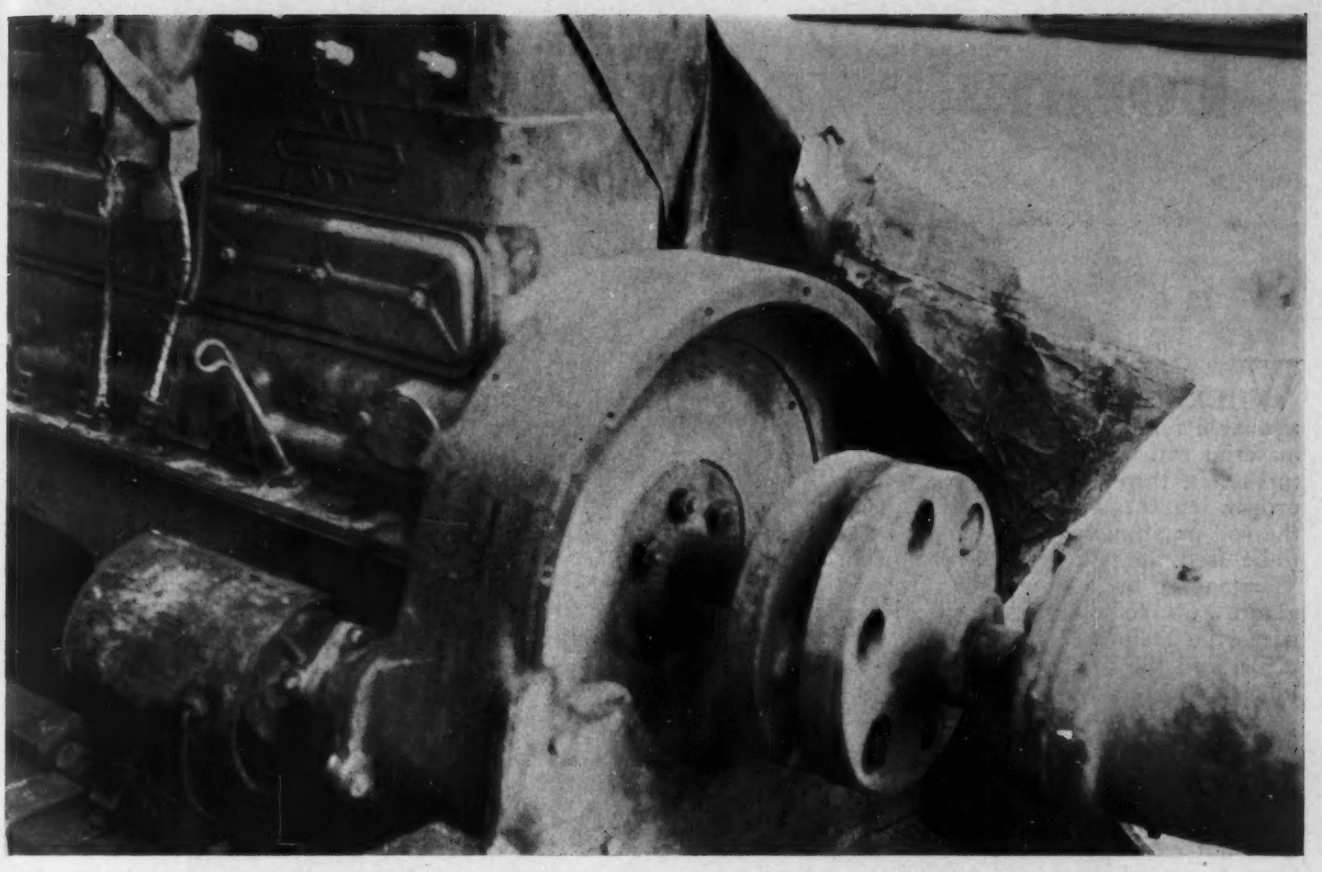
Sheet metal webbing, attached to flywheel bell housing with bolts, dowel pins and cap screws, support the automotive engine

Exhaust Manifolding

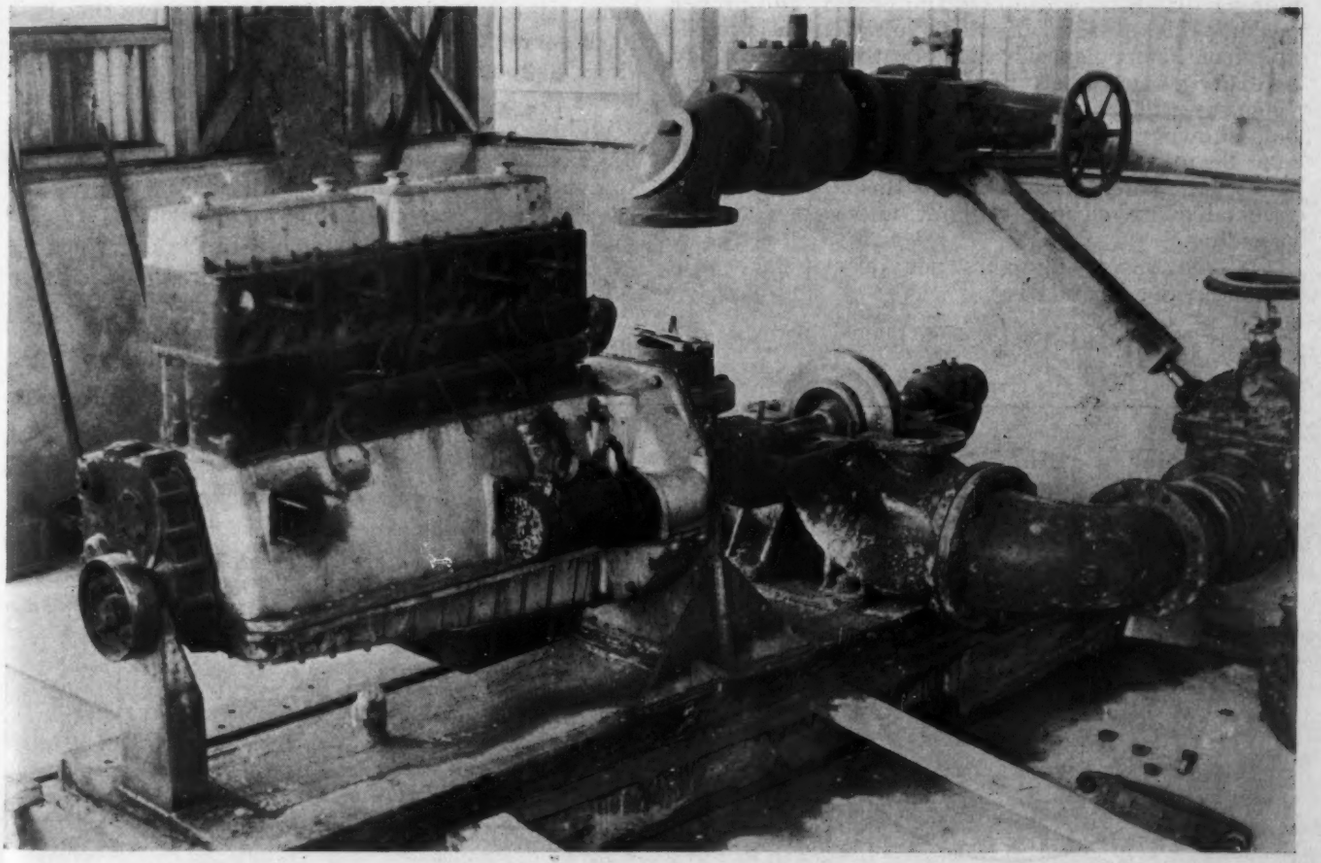
Connecting each engine to its pump was done with a conventional flexible coupling eliminating the original clutch and gear box of the bus engine. A short stub shaft, the size in diameter to match the companion section of the flexible coupling was welded to a circular plate of heavy steel trimmed to fit in the depression in the center of the fly-wheel and bolted to that member of the engine and the crank-shaft flange with adequate cap screws. The stub shaft and flange welded to it was placed in a jib to obtain the necessary straightness and afterwards faced in a lathe for finishing. The remainder of the connecting job resolved itself into routine mechanics and was done in the same manner as that accomplished with any other power drive.

With the original motor the exhaust manifold was a single casting adjusted to the several ports with conventional gaskets. Not being jacketed for water circulation, it was discarded so that special manifolds might be attached to the cylinder heads (the motors have overhead valves) and furnished with water circulating courses. Two manifold sections were made for each engine, one section for each three cylinders. For the parts fitting into the exhaust ports, welding ells were connected to a four-inch pipe inside a similar piece of six-inch. This makes a double-walled manifold, to which the risers were welded, also jacketed. Water enters through connections near the top of each riser and flows outward from the manifold jacket to provide counter-current flow of water so that effective cooling will be maintained. The ends of the welding ells intended to fit into the exhaust ports pass through a sheet of boiler plate which fits smoothly against the cylinder head, between which the usual gaskets are placed.

The original generators and starters remain with each engine to provide independent operation. The fuel used for the engines is ordinary gasoline-plant residue, prepared with the correct quantity of air with standard gas carburetors. The service which may be obtained with these converted passenger-coach and bus motors depends largely upon the attention given them while operating in the pump room. No such performance is expected of these motors that new units could supply, but since substitutions may be extended to other equipment, any type or make of motor in any kind of serviceable condition must serve for the duration.



A stub shaft with flange welded to fit into the flywheel of the engine carries half the flexible coupling, which is connected to companion flange on centrifugal pump.



Here the base has been grouted in place and forms are partly removed. The pump is partly assembled.

Formula for Exact Packing Ring Length

WHERE a mandrel of the proper diameter is not available for cutting rings from coil packing, much material can be lost, rods scored, or blow-by apertures left, through cut-and-try attempts to get the proper length. Obviously, if the circumference of the rod or plunger being packed be taken as length to be used, the packing will be too short, with a wide V extending out to the circumference of the box or gland. Conversely, if the gland circumference be used, the strip will be too long when forced into place, and the packing will be too tight for proper lubrication.

On packings of the standard braided and self-lubricated types, as on the spirally-wound metallic strip type on reciprocating service and for rotating packings in which the line speed (speed of a given spot on the rod past a fixed point in the packing) does not exceed 1250 feet per minute, an empirical formula may be used which has given satisfactory results over a wide range of service in handling boiler-feed water, brine and oil.

The formula requires the knowledge of rod or plunger diameter, width of gland or box, and proper packing thickness, all of which information is available from factory specifications on the pump, or may be experimentally determined at the first shut-down. Then, using the values derived in place of the symbols shown under the sketch, a satisfactory length may be measured off on the packing, unrolled and lying flat, which when bent to the box circle, will give adequate closure without undue pressure or crowding.

On shafts and plungers not over 4 inches in diameter, the formula is

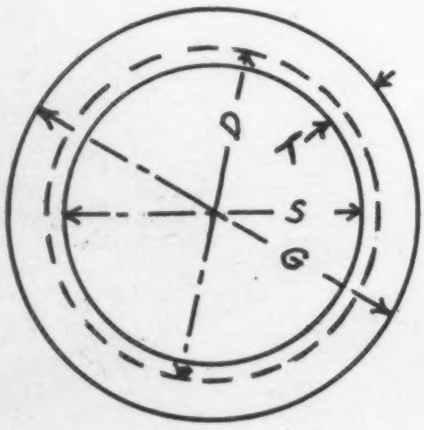
$$L = \pi\left(S + \frac{2T}{3}\right)$$

while for larger diameters the shift to the following is found to give better closure of the gap:

$$L = \pi\left(S + \frac{4T}{5}\right)$$

The formula has been developed for use on butt-cut packing, but will be equally as effective if the measurements indicated be taken on bevel cut material, the distance indicated being that along either side of the packing from the acute or sharp angle of the bevel at one end of the obtuse or wide angle at the other. This is, of course, when the bevel is at 45 degrees to the axis of plunger or shaft, and when the plane of the bevel passes through the center line of the cylindrical surface being packed.

Since the formula suggested is empirical, its use is indicated only in cases where the packing can not be measured around and cut on the part to be packed, and where pre-fabricated packing in sets is not available in the lengths and with the clearances indicated for the service to be met. Where the shaft itself cannot be used as mandrel for forming packing rings, a wooden counterpart of like diameter may be used, and possesses the added merit of not harming a highly polished part of the equipment, should the knife or hacksaw being used to cut the packing strike too deep. Where a number of packing lengths are required and a wood lathe is available, a stepped mandrel can be turned to include the more frequently used sizes, and the plunger size painted on each step or band to simplify choice of the proper length and packing size.



S = Shaft or Rod Diameter.

G = Gland or Box Diameter.

T = Packing Thickness.

D = Empirical Diameter of Cut Ring.

$D = S + \frac{2T}{3}$ (shafts up to 4 inches).

$D = S + \frac{4T}{5}$ (shafts over 4 inches).

FIGURE 1
Protective lighting of boundary fence as viewed from tower guard

Protective Lighting of Oil Refineries

R. M. SWETLAND
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THE principal objectives of protective lighting for oil refineries are: 1. to assure adequate visibility and convenience to guards under the most adverse weather conditions; 2. to assure this visibility despite possible intermittent lamp outages; and 3. to assure maximum discouragement to the would-be intruder.

There are two generally accepted and proven methods by which refineries may be lighted efficiently for night protection: by the use of boundary-fence lighting, or through the use of area lighting. The physical makeup of the refinery and its daily working schedule usually are deciding factors in the final choice of the most effective protective-lighting system.

If the plant areas are enclosed by a boundary fence with little or no plant activity at night, then fence lighting should constitute an effective solution to the problem. Whether or not a boundary fence exists, properly engineered area floodlighting will offer satisfactory nighttime protection against illegal entry to the property, and will serve the additional purpose of allowing efficient operation of the plant at night.

Boundary Fence Lighting

The design and installation of such a protective-fence-lighting system depends, for maximum effectiveness, upon: the method of patrolling the fence, whether from a patrol road behind the fence line or from guard towers near the fence, and the nature of

the terrain immediately outside the boundary line. With guarding carried out from a patrol road, the maximum illumination usually is concentrated along the fence and the area immediately outside with the guards on the patrol road in comparative shadow. Thus, they can see readily anyone approaching through the lighted area, without being detected easily themselves by the intruder. In the event of guard towers, care should be exercised in eliminating objectionable glare and brightness to the guards and in directing and controlling the light so as to illuminate effectively the critical areas either outside or inside the fence line, or both.

The presence of bordering highways, railroads, navigable waters, houses or other nearby buildings requires special planning in order to eliminate glare on such facilities that might be objectionable or dangerous to users. Usually, this is accomplished most efficiently by means of luminaires which properly shield and control the emitted light.

Street lighting luminaires with vertilateral refractors which control the light both vertically and laterally are widely used for such fence lighting, since they provide a high utilization of total lumen output, a uniform distribution of light along the fence proper, plus a sharp cutoff (or shielding effect) essential for avoiding glare and for concealment of the guards. An adjustable bracket for mounting the luminaire permits ready positioning for the proper light cutoff in relation to the desired objectives. (See Figure 1.) Units of this type are normally mounted 25 feet above the ground and spaced 6 to 12 feet back from the fence line. The linear spacing between adjacent units depends upon the size of the lamp used and upon the relative degree of illumination and visibility required. With 500 watt (or 10,000 lumen) lamps used in such luminaires, an average linear spacing of 150 to 175 feet is adhered to, normally.

All corners or angles of the fence should be illuminated by two lighting units, with the distance between the two forming a triangle with the corner of the fence. Such an arrangement will prevent loss of visibility at this point, in case of a lamp burnout.

Series circuits are found to be advantageous for the larger boundary-fence-lighting systems, involving loads of 10 kw and over, while low-voltage multiple circuits are usually more economical for smaller areas.

Entrances

Fences force all traffic through closely guarded gates where guards can demand credentials from every person who enters the plant and can check on every piece of material taken out. Adequate illumination, therefore, is of prime importance in order to provide good seeing conditions at all times for guards.

Either a 500-1000 watt wide-angle floodlight mounted 25 feet above the ground level, or two street lighting luminaires of the suspension type with symmetrical distribution will provide sufficient light for a two-lane gate. The street lights should be mounted approximately 25 feet above the ground on opposite sides of the gateway.

Water Boundaries

Areas of refineries that border navigable water should have enough light to facilitate detection of attempted entry from that direction. Care should be

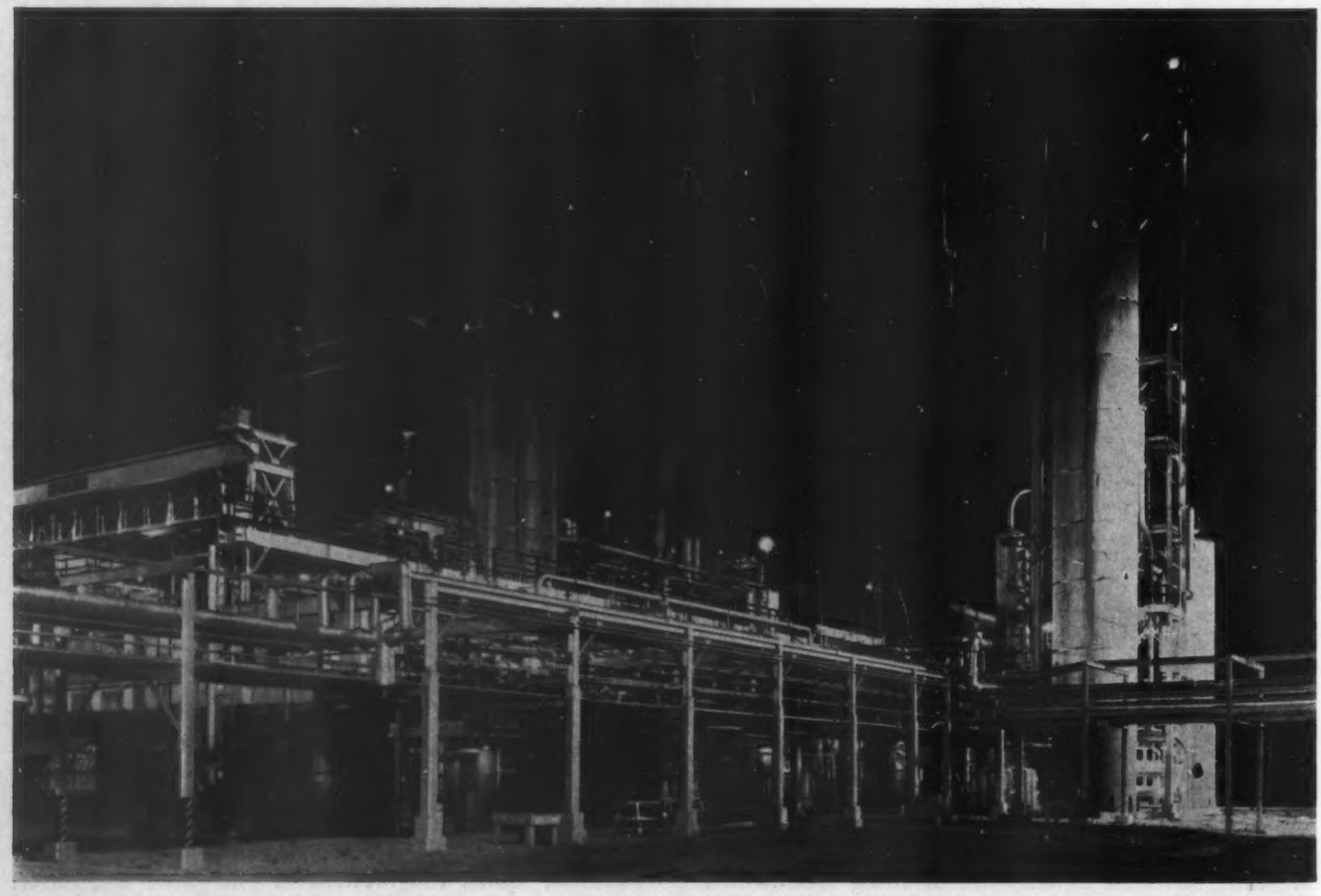


FIGURE 2
Example of good area floodlighting for night protection

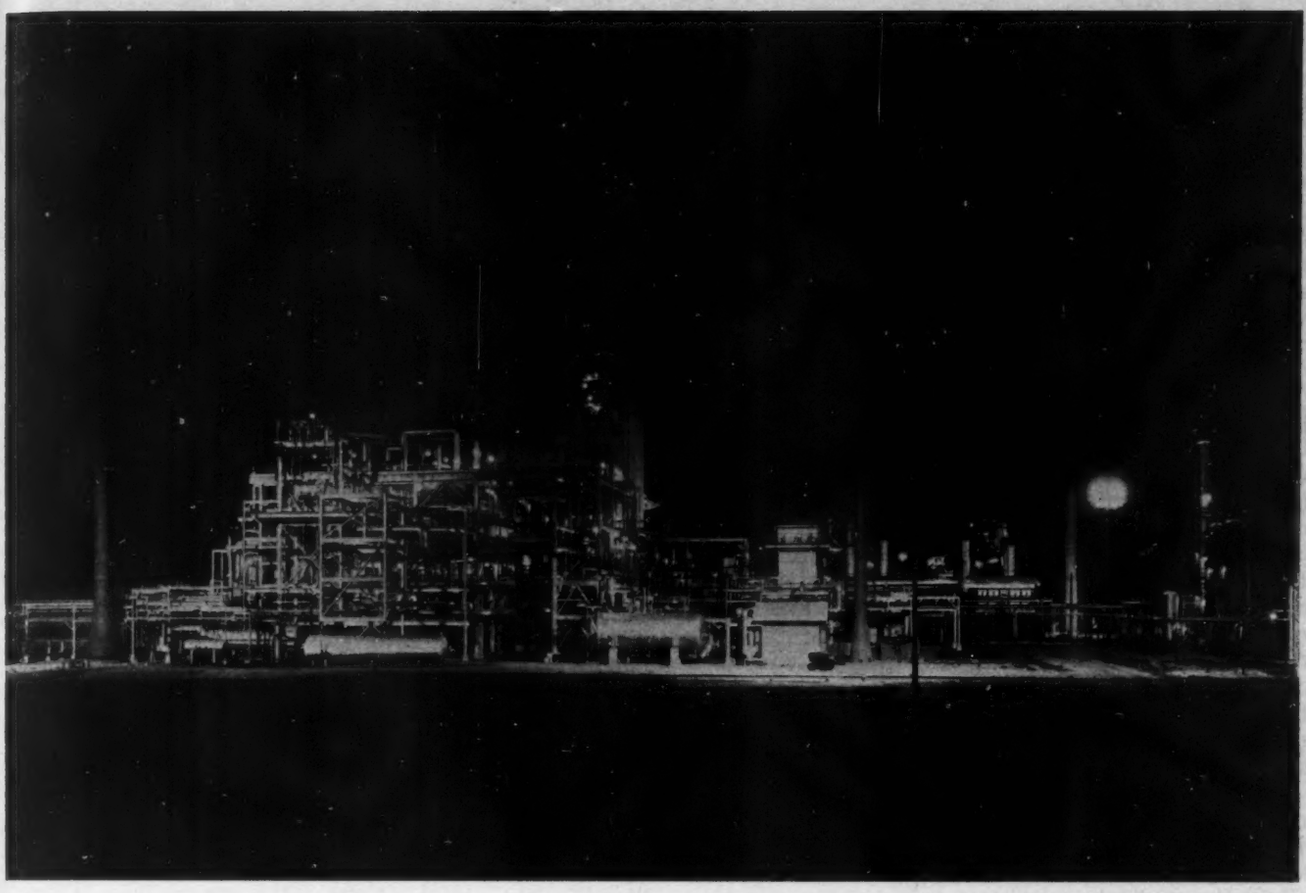


FIGURE 3
As the area looks to the would-be intruder. The bright border of light which takes the place of a fenceline offers quick discovery of alien presence to guards or policemen.

taken to minimize glare to river traffic by mounting floodlight and searchlight equipment 30 feet or more above the water and directing the light either at right angles to the direction of water traffic, or with the direction of the traffic.

Usually, some provision should be made for illuminating any docks and wharfs which are not used at night, since these critical areas might well constitute a desirable objective for the saboteur.

Area Lighting

Ordinarily, general illumination of the whole refinery area is completely justified in the event of plant activity at night. The physical construction of most oil refineries is so complex that lighting well distributed over the whole area is advised. Partially lighting such plants introduces the possibility of hunting for intruders amid the many shadows created by such obstacles as pipe lines, cracking equipment, and towers.

While several methods are available for general illumination of refining plants, the use of floodlights mounted on towers or poles, properly located for most effective light distribution, has proven to be one satisfactory answer to these requirements. In many cases, there is a distinct advantage in placing such lighting equipment on towers located at safe distances from particularly hazardous zones containing highly inflammable materials.

A typical floodlighted refinery area is shown in Figures 2 and 3. The average level of illumination recommended for this whole area was about 1 footcandle, supplied by general-utility enclosed floodlights with 1500-watt general-service multiple lamps. A total of 56 floodlights was used, with a mounting height of approximately 75 feet which assures substantially uniform light distribution over the whole plant. These towers (10 in number) are stepped to facilitate servicing, and are so located that no dark shadows have been created as hiding places for the would-be saboteur.

Isolated groups of storage tanks, whether fenced or not, can be lighted adequately with the type of luminaire recommended for fence lighting. These units should be so spaced as to eliminate shadows between the tanks and to provide good lighting for the tank stairways. Where local conditions will permit, the luminaires should be located on both sides of, and about 75 feet back from, the tanks. In some cases, however, the presence of some obstructions may make a closer installation necessary.

Blackout Control

Every protective-lighting system should be so designed that a quick and easy blackout is possible during an emergency. If the lighting is controlled by an automatic time switch a manual switch, which will enable a guard to switch off the entire lighting system instantly, can be inserted in the control circuit.

Supplementary Lighting

Supplementing the protective-lighting systems described above, 18-inch incandescent searchlights are often used to facilitate the investigation of areas under suspicion which may not be adequately lighted by the fixed lighting system. The pilot house control type of searchlight is especially advantageous for guard tower installation.

Abnormal Care Will Force the Air Compressor to Give Abnormal Service

EACH of the units which has a place in the complete plant for processing crude oil or extracting natural gasoline is of key importance to the petroleum industry in these days when it is called upon for large quantities of products with constantly diminishing stocks for repairs and replacement materials. Each piece of equipment must receive special care if it is to continue to function satisfactorily past the time when it would be withdrawn from service and overhauled, or perhaps replaced by a new unit. One of these special units which, by the nature of its service, requires special attention and individualized upkeep is the air compressor.

The equipment which goes to make up a complete compressed-air system; the compressors, compressed-air lines, intercoolers, after-coolers, and receivers, needs constant care if they are to perform their duties efficiently with the minimum of maintenance and service interruption, and thus to keep operating at capacity.

In the operation of compressed-air equipment, it is important that the original installation be correctly made, that the compressors and pipe lines be properly placed with respect to each other, that lubrication be carefully carried out, that the whole unit be kept clean, protected from dust and dirt, and systematically inspected and maintained.

Starting Up a Unit

In starting a new reciprocating compressor or an old one which has been overhauled or is being put on the line after being out of operation for sometime, it is necessary to see that the crankcase is carefully cleaned of grit and other foreign matter and filled to the proper level with suitable oil. Cylinder lubricators likewise should be flushed and filled with oil suitable for cylinder lubrication.

The operator is cautioned never to use kerosine, gasoline, or other light petroleum products in flushing out cylinders or compressor frames. They are volatile and dangerous to use. It is better to waste a little lubricating oil in the process. Care should also be taken not to use waste or rags which leave a lint deposit, possibly to clog oil passages, block close clearances or possibly ignite under compression temperatures.

When mechanical lubricators are filled, it is good practice to break each oil-line joint nearest the cylinder or feed point and crank the lubricator by hand until oil appears at the open joints. This done, the operator can reconnect the piping with assurance that the cylinders will be provided with oil immediately upon starting.

Packing of the stuffing boxes should be carefully done. Any packing used should be thoroughly coated with oil. If soft packing is to be employed, it should be soaked in a suitable compressor oil overnight so as to impregnate it as thoroughly as possible. The packing should not be pulled too tightly at the start, as this is liable to score the piston rods; rather the gland may be pulled up gradually after the compressor has warmed up and tightened just sufficiently to prevent blow by along the rod. (See Figure 1.)

Before starting, make absolutely certain that the intake line has been thoroughly blown out and cleaned of all dirt, welding shot, scale, and other foreign matter. Many new or overhauled compressors have had their valves and cylinder walls badly damaged by sucking in such foreign matter.

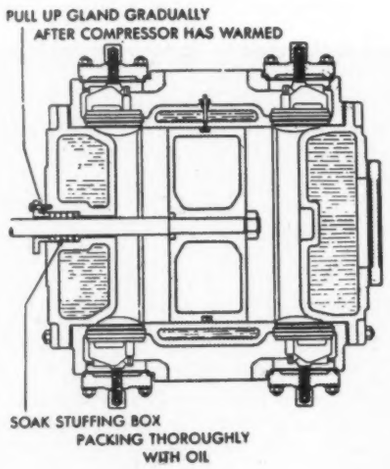


FIGURE 1

Packing of stuffing boxes should be carefully done, with the packing thoroughly soaked with oil. The gland should be pulled up gradually after the compressor has warmed up, and tightened just sufficiently to prevent blowby along the rod.

The cooling water should then be turned on to make sure there are no leaks in the water lines or in the cylinder jackets and that there is no stoppage of water flow. Jacket lines should be so connected that the flow of water may be observed either into an open funnel on the discharge or by means of sight pressure glasses, if a closed system is used (See Figue 2). The circulating water lines from both cylinders and coolers should have drain valves at the lowest points to permit the entire system being drained in cold weather if the equipment is shut down.

To make sure that all parts are clear before starting the compressor, the operator should turn the

equipment over several times by hand. To start the compressor, the power should be turned on gradually. It is well during the first few hours to start and stop the machine intermittently, feeling the various bearings for excessive temperature. It is common practice to run in a new machine with the compressor valves removed in order that the equipment may be broken-in gradually under no load. Make cer-

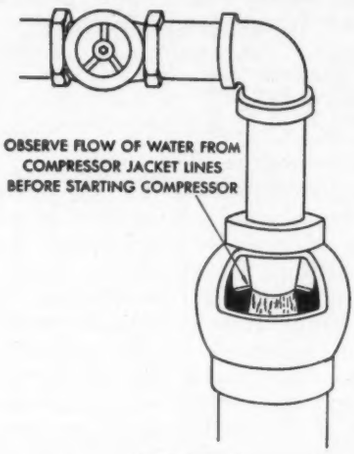


FIGURE 2

It is important that the flow of water through jacket lines be observed. An open funnel as shown here or sight pressure glasses are recommended.

tain when starting up that all working parts requiring lubrication are getting plenty of oil and that no part is heating up. After several hours' operation in this manner, the valves may be replaced, making certain that the jam screws which hold the valves on their seats are screwed down firmly. The machine may then be started with all the valves installed, being careful to build up the pressure slowly over a period of several hours.

If the source of power is steam, the drains on the steam cylinder and the steam pipe above the throttle must be opened before the compressor is started, to eliminate condensation. The throttle valve should be open a very small amount before starting to permit a small amount of steam to pass into the steam cylinders to heat them up gradually. After these cylinders are heated, the throttle valve should be open a very small amount to permit the compressor to turn over slowly. If the compressor is of the single-crank type, it may be necessary before starting to bar it over beyond dead center.

In the operation of air compressors, it is excellent practice to establish an engine-room log requiring the recording of operating data at definite periods throughout the day; also the log should record what routine daily inspections must be made, as well as what weekly and what monthly inspections should be established. As an example, instead of running the compressor without shutdown until there is evidence of a broken part, the valves should be removed and carefully examined every 6 months (every 2 months if the equipment is in 24-hour daily use). The log should also require an examination of the cylinder walls, to make certain the cylinder is properly glazed and adequate lubrication is provided. The interior of compressor cylinders may be examined with the aid of a flashlight by removing a valve.

If the equipment is operating properly, the valves should have an oily surface and be comparatively free from carbon. When reassembling, the operator should be careful to keep each valve assembly together and not to interchange parts. If any head gaskets are replaced, extra care should be taken to insure water ports being cut in the gaskets, which must correspond in size and location with the ports in the cylinders and the heads. Failure to do this would cause overheating and possible serious damage.

At predetermined periods, the entire compressor should be carefully inspected for the presence of worn parts, new packing where needed, changing of oil in the crankcase, and inspection for complete overhaul of the equipment if it has had considerable use. If the inspection system provides definite routine inspection for every purpose, the equipment will be very much better maintained and cared for, with less interruption to service and lower cost of compressed air.

It is essential to examine the water jackets (Figure 3) at frequent intervals and thoroughly clean them. Their condition is the best evidence of the suitability of the cooling water that is used. The presence of heavy, hard scale in the jackets forms an insulation which prevents effective heat interchange. The jackets can be cleaned either by a pressure jet of water for any silt or other soft deposits, or by dilute acids if the scale is hard. The acid, 10-percent hydrochloric (muriatic), may be forced through the jackets by a small circulating pump, or by running it from a container placed above the cylinders. It is important to neutralize the acid effect in the jackets with alkali after the acid treatment to avoid any damage being done to the metal exposed to its attack. Inhibited acid will remove scale with minimum risk to equipment.

In the operation of two-stage compressors, a disturbance of the normal intercooler pressure is one of the first indications of trouble. If the intercooler pressure rises, there may be something wrong in the high-pressure cylinder, such as leaky or broken intake valves or a defective piston ring. If the intercooler pressure falls below normal, trouble may be looked for in the low-pressure cylinder. Such a defect may also be observed by overheating of either discharge

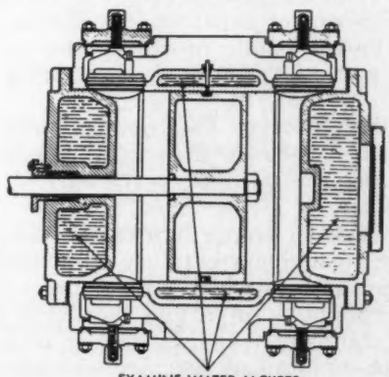


FIGURE 3

Water jackets of compressors must be examined at frequent intervals and should be thoroughly cleaned regularly.

or suction valves. If the valve covers are unusually hot, there is evidence of leakage, which may be either in the valve or a blown out gasket between the valve and the cylinder. If there is a metallic knock in the compressor cylinder during each revolution, there is evidence of something being loose. The valve jam screw may not be holding the valve firmly against the cylinder, the pressure causing the valve seat to

clatter against the cylinder; or the piston may be loose on the rod. These warnings should be promptly investigated to head off any serious damage about to occur. For instance, if the jam screw is not down tight, allowing the valve to pound up and down every revolution, the valve seat may break, causing a broken part to fall into the cylinder. The machine may be very seriously damaged by such a broken part falling into the path of the piston. Most cases of broken valve seats are caused by the valve being loose, although such a condition always gives ample warning.

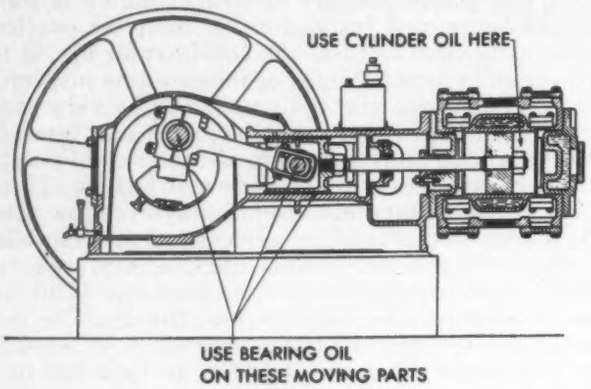


FIGURE 4

Compressor cylinders require cylinder oil and the running gear, crankcase or bearing oil.

Lubrication

Under the augmented loads of war-time demands, when air and gas compressors are driven at maximum capacities for 24 hours per day, 7 days out of every week, lubrication must be carefully maintained. Improper lubrication or equally as serious lack of lubrication may cause serious delay or drop in production or throughput by failure of equipment at a critical time.

When lubrication is improperly carried out, and damage to cylinder walls, bearings or valves results, a major shutdown for repairs is inevitable, and much time may be lost while procuring the necessary replacement parts, or even in the reworking of present units.

Lubrication involves the complex problem of selecting the proper oil for the part to be lubricated and in seeing that the oil is properly applied and in the proper amount.

The first rule in proper lubrication of compressors or any other machinery is to use oil according to any special specifications which may be prescribed by the compressor manufacturer, and then deal with a reputable oil company which is willing to guarantee a lubricant of maintained specification satisfactory for the service for which it is intended.

As many as three different types of oil may be re quired by a reciprocating compressor, one type for the compressor cylinders, another for the bearings of the driving gear, and a third for the power cylinders, provided the source of power is steam, diesel, or gas engine.

Oil intended for compressors of the single-acting trunk piston type must be suitable for both the compressor cylinders and the running gear, and must be of the type known as compressor-cylinder oil with specifications suitable for the particular machine. Double-acting piston-type compressors, in which the frame running parts and the compressor cylinders are completely separated, require cylinder oil for the compressor cylinders and crankcase or bearing oil for the running gear (see Figure 4).

Compressors vary so widely as to type and use as to make it impossible to prescribe an oil specification completely suitable for every condition. The following specifications for compressor cylinder oils are taken from the Trade Standards of the Compressed Air Institute, which would apply generally to most air compressor installations. These are:

Flash point .....350° F., minimum
Viscosity S.S.U. at 100° F.....245 minimum
Viscosity S.S.U. at 210° F.....45 minimum
Pour point, plus 35° F.....Maximum
Neutralization Number .....0.10 maximum
Conradson carbon residue 2.0 percent.....Maximum

Special requirements call for special treatment. If a gas compressor, special consideration must be given the question of cylinder lubrication. Various gases have a high affinity for oil, leaving the cylinder walls dry and unlubricated. If the cooling water is of a much lower temperature than the incoming air or gas, condensation is formed on the cylinder walls, with resulting poor lubrication. The answer in such cases may be to heat the cooling water to more nearly the temperature of the intake air or gas (see Figure 5). The ratio of the initial and final pressures developed in cylinders has an important bearing on the oil selected, as this in great measure determines the maximum temperature prevailing in the cylinder. The size and the speed of the compressor also has considerable influence on the discharge temperature of a compressor cylinder.

The amount of oil required in a compressor cylinder will vary somewhat with the type of machine, its speed, and local conditions of operation. It is good practice to use oil liberally while the machine is new and until the cylinders have been glazed. The quantity of oil should then be gradually reduced, using care to examine the cylinders occasionally by removing a valve to ascertain that the walls are amply coated with oil. Provide an ample amount of oil, but do not overlubricate, as excessive oil in the discharge is very undesirable and to be avoided. Table 1 gives the minimum allowable rate of feed under ideal operating conditions, but the use of this table should be amplified by frequent examinations of the cylinder walls as previously stated.

Steam cylinder oil may vary appreciably, depending upon steam temperature. For moderate steam temperatures, the following specification as taken from the Trade Standards, is offered:

Flash point .....500° F., minimum
Viscosity S.S.U. at 210° F.....Seldom less than 100
Pour point .....80° F., maximum
Conradson carbon residue left on evaporation..4.5 maximum
Compounding.....0 to 12 percent maximum

Entirely different considerations are required for

TABLE 1

Cylinder Diameter, Inches	Piston Displacement per Cylinder, c.f.m	Swept Surface per Cylinder Square Feet per Minute	Oil Feed per Cylinder	
			Drops per Minute	*Pints per 10 Hours
Up to 6.....	Up tp 65	Up to 500	2 d. in 3 m.	.05
6 to 8.....	65 to 125	500 to 750	1	.075
8 to 10.....	125 to 225	750 to 1,100	4 d. in 3 m.	.10
10 to 12.....	225 to 350	1,000 to 1,500	1–2	.112
12 to 15.....	350 to 600	1,500 to 2,000	2–3	.188
15 to 18.....	600 to 1,000	2,000 to 2,600	3–4	.262
18 to 24.....	1,000 to 1,800	2,600 to 3,600	4–5	.338
24 to 30.....	1,800 to 3,000	3,600 to 4,800	5–6	.412
30 to 36.....	3,000 to 4,500	4,800 to 6,000	6–8	.525
36 to 42.....	4,500 to 6,500	6,000 to 7,500	8–10	.675
42 to 48.....	6,500 to 9,000	7,500 to 9,000	10–12	.825

* Figures in last column are based on 8000 drops per pint at 75° F.

the lubrication of both rotary compressors and centrifugal compressors and exhausters. Most of the different types of rotary compressors and vacuum pumps employ different lubricating specifications. It is extremely important to follow the instructions of the manufacturer carefully.

Centrifugal compressors and exhausters require bearing lubrication only, and in overhung units with

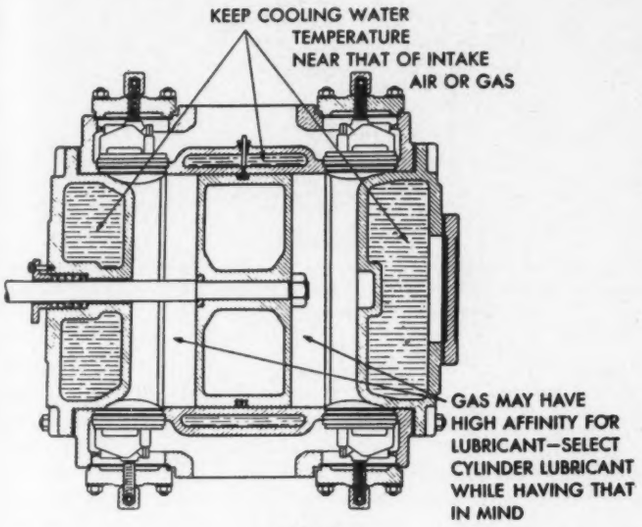

KEEP COOLING WATER TEMPERATURE NEAR THAT OF INTAKE AIR OR GAS
GAS MAY HAVE HIGH AFFINITY FOR LUBRICANT—SELECT CYLINDER LUBRICANT WHILE HAVING THAT IN MIND

FIGURE 5

The temperature of the cooling water should be as close to the temperature of the air or gas in the compressor as possible, to minimize the condensation on the cylinder walls.

no bearings of their own, only the driving mechanism is lubricated. Ball or roller type anti-friction bearings on small pedestal or multi-stage units require grease or oil in the usual manner. Larger and higher speed units generally have pressure-lubricated sleeve bearings. Consult and follow closely the manufacturer's recommendations.

Auxiliary Upkeep

Even the most efficient and carefully maintained compressor cannot give the high standard of service necessary to meet the maximum war demand unless the auxiliaries which go to make up the complete plant, such as piping, after-cooler, receiver and valves are properly designed, installed and maintained.

Starting at the intake, it is important that the air be drawn from as cool and clean a location as possible. The weight of air handled by a compressor varies inversely as the absolute temperature of the intake. If, therefore, the intake can be reduced from 80 to 60° F., the compressor will handle about 3.75 percent more capacity. If dust or foreign matter is continually drawn into the machine, it causes rapid wear of the working parts, which means high maintenance and interruption of service. Much fouling of the intake may occur if the intake line is near an exhaust or stack which belches smoke, fumes, and harmful dust, or if the intake opens out onto a highway, railroad line, a plowed field, or is near a coal or ash bin or a crushing plant.

Efficient filters should always be installed on the intake of compressors, and the operating log should call for cleaning these filters at stated periods. The intake should come from outside of the building where the air can be obtained as cool as possible. It is often beneficial to have the air intake near the roof of the building, if the air is of better quality at that point, or on the north side of the building rather than the hot side, if convenient. The intake pipe should be turned upward so that the air is taken from at least 10 feet above the ground, to avoid sucking grit from the ground level, and it should be protected from the weather so that rain is not permitted to enter (see Figure 6).

The intake piping should be as short and direct as possible, with long radius elbows where turns are necessary. If not over 12 feet, the intake pipe diameter should equal the diameter of the opening of the compressor cvlinder; if the pipe is longer, its diameter should be increased to the next size larger.

The necessity for thoroughly cleaning of suction lines cannot be over-emphasized. Welding shot, scale, or other foreign matter when pulled into a compressor frequently is the cause of serious damage to the compressor cylinder. Always make certain that this pipe has been thoroughly cleaned. And the frequent finding of a pair of overalls in the suction line is not just a myth.

If a large cemented tunnel is used for the suction line, it should be carefully glazed and surface-treated to insure against cement dust being pulled into the compressor.

Above ground, the pipe should be standard steel or spiral riveted; below ground it may be of glazed vitrified clay with all joints carefully cemented to make them water tight.

Discharge lines should be of ample size, for lines of too small diameter result in excessive pressure drop. Larger pipe lines are especially desirable where the air lines are long. Sharp bends and elbows also increase the friction loss and should be as few as possible.

Air from the compressor discharge contains moisture, which is deposited as the air is cooled while traveling through the air lines. The presence of water

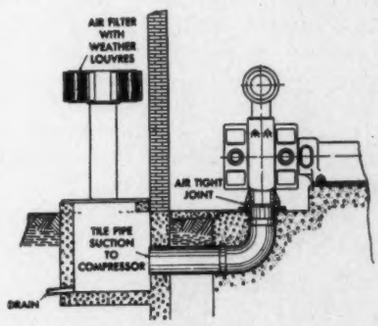


FIGURE 6

The intake pipe should be turned upward so that the air is taken from at least 10 feet above the ground, to avoid sucking grit from the ground level, and it should be protected from the weather so that the rain is not permitted to enter. The intake pipe should be as short and direct as possible.

in the lines is very harmful for many reasons. It may give rise to leaks at the joints or it may freeze in the pipes in exposed places. The major danger, however, occurs to pneumatic tools where the water, by washing off the lubrication, causes the tools to wear very rapidly, and in other ways, interferes with their normal operation. Water in the compressed air causes a loss of man-hours where the air is used for blowing chips, etc., as the operator must blow the lines free of water before he can use air.

Aftercoolers are installed to remove as much of the moisture in the compressed air as possible at the

compressor before entering the main air lines. It is obvious, however, that the amount of moisture that can be removed by the aftercooler depends largely upon the temperature of the cooling water. Therefore, the circulating water for the aftercooler should be as low a temperature as possible for maximum moisture

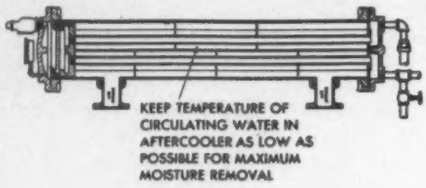


FIGURE 7

Circulating water in the aftercooler should be at as low a temperature as possible for maximum moisture removal.

removal (see Figure 7). It is also obvious that, if the air in the air lines is cooled by room temperature to below the temperature of the air at the outlet of the aftercooler, some additional moisture will be precipatated in the air lines, although the amount will be small.

The aftercooler should be placed as near to the compressor as possible, and a receiver of liberal size should be installed directly beyond. The receiver is helpful in taking care of instantaneous peaks but its use is primarily to eliminate pulsations in air lines and permit a steady and mean velocity through them. As a result, the air line beyond the receiver may be smaller than the line between the receiver and the compressor, which latter should never be choked down. Receivers should also be located in the various departments where the air is used, if these are some little distance away from the compressor house, in order to give a constant supply of reasonably dry air.

All air receivers have drain cocks located near the bottom which must be drained daily, or, if no aftercoolers are used in the system, the receiver should be drained several times per day on damp, humid days when the air contains maximum moisture. Safety valves on receivers should be tested occasionally by lifting the valve levers or raising the pressure to operate the valves, to insure their being in proper condition (see Figure 8).

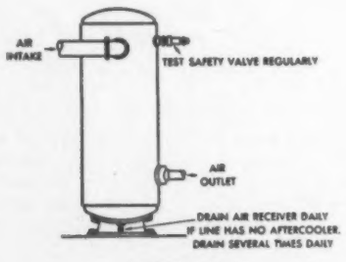


FIGURE 8

The drain cocks at the bottom of air receivers must be drained daily, but if aftercoolers are used in the system, the receivers should be drained several times during the day. Safety valves on receivers should be tested occasionally by lifting the valve levers or raising the pressure to operate them to insure their being in proper condition.

It is obvious that a shut-off valve should never be placed in the line between the compressor and the receiver unless a safety valve is placed on the compressor side of the shut-off valve. Operators will forget to open the shut-off valve upon starting the compressor, causing serious damage to the machine (see Figure 9). For the same reason, it is necessary to install a safety valve between the compressor and the first shut-off valve in the pipe line, if the compressor is connected into an air main with other compressors.

Leaks in the piping system are perhaps one of the most common and most easily corrected losses in a

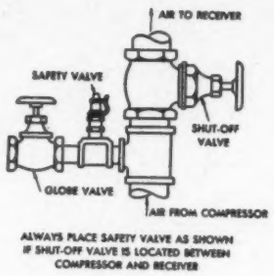


FIGURE 9

If a shut-off valve is placed in the line between a compressor and receiver and a safety valve is not also inserted as shown, serious damage to the machinery might occur.

compressor plant. Air leakage, unlike many other forms of pipe-line leakage, is easily found due to the noise of even a small stream of escaping air. The financial loss from leaks in compressed air lines can assume considerable proportions. The leakage of air at 100 pounds pressure through a single 3/8-inch orifice would amount to roughly 6,000,000 cubic feet per month; at 6 cents a thousand cubic feet, this loss would amount to $360 per month. Air lines, air hose, shut-off valves, and other connections should be tested when the plant is not in operation, by charging the lines at working pressure and shutting down the compressor to see how rapidly the pressure drops.

There are, of course, various ways of testing for leakage, such as holding a candle flame close to the joint to see whether the flame will flutter; soapy water may be swabbed around the joints, and, if there is a leak, it will produce a soap bubble (see Figure 10).

All air hose connections should be made from the top of the distribution lines so that the hose will not pick up any moisture that may lie in the bottom of the line. The air line should be blown out well before it is connected to a pneumatic tool. On most air lines, high-pressure-hose couplings are required.

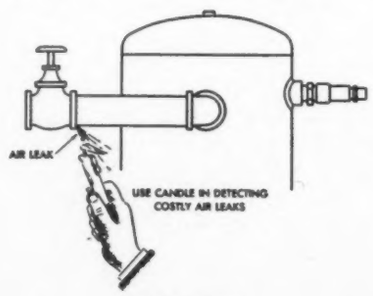


FIGURE 10

A candle flame may be used to detect leaks in air lines. To test for leaks in gas lines, soapy water may be swabbed around the joint, and if there is a leak, it will produce a soap bubble.

To maintain the hose in proper condition, it should be turned end for end occasionally. All kinks should be avoided, but, when they do occur, they should be carefully untwisted. The hose should be drained and kept on racks in cool, dark storage when not in use.

What Is Chemical Notation All About?

PAUL H. FAUST
Chief Chemist, General Petroleum Corporation

ALL too often the man who has not studied chemistry turns away from a formula under the conviction that he cannot understand it. So long as he turns away he never will understand the combinations of capital letters and numerals, which are the shorthand of the laboratory.

In this article the author has gone into chemical formulae in an elementary manner as a means of giving the men who do not have benefit of technical learning a better means of understanding the several other articles which will make up the series on the several processes.

Any man, provided he can read, can get some knowledge of chemistry by study. This elementary presentation is a chance for study, offered especially for the younger men who have come into refining plants and the older ones, who are expert in operating equipment but not informed as to what takes place in processing.

A FEW years ago one was seldom confronted with chemical formulas in trade journals of the oil industry. Hence, it is not surprising that many oil men are not familiar with the "chemist's shorthand" that now is covering pages of petroleum literature. This article is intended to relieve such a handicap somewhat, by defining a few pertinent terms and citing specific examples of chemical notation.

A chemical formula expresses the composition of an individual chemical substance in terms of members of a group of 92 materials called elements. Of these comparatively few substances, the hundreds of thousands of known chemical compounds are ultimately composed. One does not speak of the formula of wood or steel or, as a matter of fact, of most of the things with which we are familiar; for these are really mixtures of different substances, not pure chemical compounds.

The terms atom and molecule refer to the fundamental particles of elements and compounds respectively. Compounds result, ultimately, from the combination of atoms to form molecules.

In the petroleum industry the gases are the only constituents of crude oil that are ordinarily separated into pure compounds. We may speak of the composition of a gasoline in terms of the approximate percent of olefins, paraffins, and aromatics; but never of the chemical formula of gasoline. We do speak of the formula for methane, butane, octane, etc., for these are individual compounds, and individual compounds may be described by chemical formulas.

The formula for methane is CH_4. The letters C and H are called symbols; they indicate the presence in the compound of the elements carbon and hydrogen. They represent also a definite characteristic weight, called the atomic weight, of the element. The number of atoms of each element in the molecule is shown by a subscript; thus methane contains four hydrogen atoms, one carbon (the subscript "1" is understood).

The atomic weight of hydrogen is 1, and of carbon, 12. Considering the numbers of each atom present, the molecular weight of methane adds up to 16, and the 2 elements are present in the ratio of 3:1 by weight. Whether we talk of milligrams or tons, we know from this that if all the carbon in methane could be obtained, say in the form of lampblack, the weight of lampblack obtained would equal three-fourths of the weight of methane used.

Chemical reactions are expressed in the form of equations which relate the reactants and the products so that the same weights of each are equated. The formation of carbon by decomposing methane may be expressed by the following equation: (The relative, atomic or molecular, weights are placed below the formulas for illustration.)

$$\begin{array}{c} CH_4 \rightarrow C + 4H \\ 16 = 12 + 4 \end{array}$$

When hydrogen atoms are formed they have a powerful inclination to combine with each other according to the equation,

$$2H \rightarrow H_2,$$

where 2H represents two uncombined atoms of hydrogen, while H_2 represents a molecule of hydrogen consisting of two combined atoms.

By combining these two expressions, just as if they were algebraic equations, we obtain the conventional form

$$CH_4 \rightarrow C + 2H_2$$

The primary object of this article is merely to suggest the meaning behind a formula or an equation; the reader is referred to any elementary textbook of chemistry for elaboration of the ideas thus far presented.

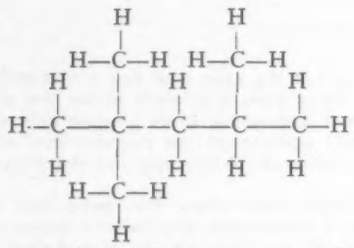
The wide variation that may be encountered in the particular ways chemical names and formulas

may be written is likely to prove confusing. Several different ways of expressing two compounds, iso-octane and styrene, are given to illustrate the variety possible.

1. *Iso-octane.* When used in a singular sense this term has come to mean one particular compound, but it is not, chemically speaking, a definitive term. It actually pertains to any eight carbon paraffin hydrocarbon with an open, branched chain.

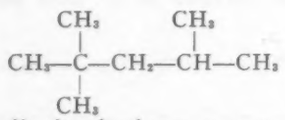
2. *2,2,4-Trimethylpentane.* This is a defining term, the proper one if ambiguity is to be avoided. The numbers, (2,2,4) specify positions on the longest string of carbons in the molecule (pentane) upon which three methyl (trimethyl) groups are substituted. (Compare with the structural formulas that follow.) For obvious reasons, when such complicated compounds have "popular names" like *iso-octane,* these are ordinarily used.

3.



This is a variation of the structural formula for iso-octane, the one that is most descriptive of the actual appearance of the molecule, in that it represents each atom by a letter. (However, the spatial arrangement is neither planar nor rectangular in the actual molecule.)

4.



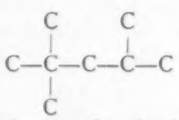
In this form all the hydrogens connected to any one carbon atom are represented by one H with a subscript to indicate the actual number.

5.

$$CH_3C(CH_3)_2CH_2CH(CH_3)_2$$

Here the formula has been written on one line; the side groups connected to a particular carbon follow in parenthesis. This is the ideal variation from the printer's point of view.

6.



In this "skeleton" form, the hydrogens are left off for the sake of clarity. It is a popular shortcut when the structure of a hydrocarbon is to be emphasized.

7.

$$C_8H_{18}$$

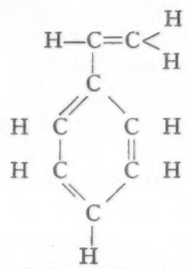
This is the "empirical" formula for iso-octane, as well as for any other eight-carbon paraffin. Because it describes not one, but a group of substances, its usefulness is limited.

Consideration of the second compound, styrene, illustrates notations peculiar to the benzene ring configuration.

1. *Styrene, styrole, cinnamene.* These terms are all synonymous and specific, although the first is used almost exclusively.

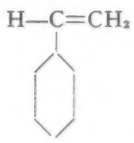
2. *Phenylethylene, vinylbenzene.* These names are specific also, but they, unlike those above, describe styrene in terms of simpler constituents. The phenyl group (benzene ring) and the ethylene, or vinyl group, are illustrated in the following formulas.

3.



This is a structural formula showing how the benzene ring and the ethylene group are joined in the molecule.

4.



Here, the formula has been shortened both by using a subscript and by employing a hexagon to represent the benzene ring, eliminating the C's and H's within the ring. This is such a common shortcut that the written-out form of benzene is almost never seen.

5.

$$C_6H_5CH{=}CH_2$$

In this one line structural formula for styrene the C_6H_5 grouping stands for the benzene ring.

6.

$$C_8H_8$$

The empirical formula for styrene suffers the same indefiniteness as that for iso-octane, although in this case there is no well-known compound that possesses the same formula.

Some Physical Properties of Butadiene and Styrene

LAWRENCE A. WOOD and CATHERINE F. HIGGINS
National Bureau of Standards

WITH the expansion of the production of synthetic rubber in the United States the National Bureau of Standards has received a number of requests for data concerning the physical properties of the raw materials used for making synthetic rubber. The variety to be produced in largest amounts is Buna S, and consequently data are very often required for butadiene and styrene, the materials which are copolymerized to make Buna S.

A search of the literature has been made, and certain properties have been measured at this Bureau in the course of investigations, the results of which in many cases have not yet been published. The values which are regarded as the most reliable at the present time (December, 1942) have been collected and put into tabular form. They are presented at this time in order to meet an immediate demand for such data. It should be recognized that in most cases they have not been checked by independent observations. Revisions will be made as further information becomes available.

Especial thanks are due to the Phillips Petroleum

Some Physical Properties of 1,3-Butadiene

Alternative Names: Biethylene, Bivinyl, Divinyl, Erythrene, Pyrrolylene, and Vinylethylene

(Metric System Units)

Property	Value	Source
Molecular weight of C_4H_6	54.088	
Normal boiling point	−4.6° C.	1
Freezing point	−108.9° C.	1
Density of vapor at 0° C. and 760 mm. of mercury	0.00248 g·ml^{-1}	4

Density of liquid in g·ml^{-1}

Temp.	−20°	0°	20°	25°	40°	60° C.
Value	0.6690	.6455	.6210	.6146	.5958	.5682

Source: 3

Thermal expansion (liquid) from −20° to +60° C., t in ° C.: $V = V_0 (1 + 1.8528 \times 10^{-3} t + 5.148 \times 10^{-6} t^2 + 29.2 \times 10^{-9} t^3)$ — Source: 3, (2)

Vapor pressure from −80° to +40° C.: $\log_{10} p = 6.96128 - \frac{973.6}{t + 243.2}$ — Source: 1

t in ° C.	−78.51°	−4.6°	0°	25°	40° C.
p in mm. of mercury	11.2	760	908	2144	3338

Rate of change of boiling point with pressure at the normal boiling point	0.0334 (° C.) · (mm. of mercury)$^{-1}$	1
Heat of vaporization at normal boiling point	99.80 cal·g^{-1} 5398 cal·mole^{-1}	1
Heat of fusion	35.28 cal·g^{-1} 1908 cal·mole^{-1}	1
Heat of formation of vapor at 25° C.	26,865 cal·mole^{-1}	5
Heat of combustion of vapor at 25° C. at constant pressure (1 atmosphere)	11,055 cal·g^{-1} 607,940 cal·mole^{-1}	5, (2)
Specific heat of liquid at 25° C.	0.517 cal·g^{-1} (° C.)$^{-1}$	1
Refractive index for D-line at −25° C.	1.4293	6
Unit cell of crystalline material	a = b = 13.20 Angstrom units c = 8.46 Angstrom units	7
Limits of flame propagation in mixtures with air	2 to 11.5% (by volume) of butadiene	8

(British Engineering Units)

Property	Value
Normal boiling point	23.7° F.
Freezing point	−164.0° F.

Apparent density in air in lb·gal^{-1} (U. S.)

Temp.	0°	20°	40°	60°	80°	100°	120°	140° F.
Value	5.550	5.445	5.333	5.221	5.101	4.988	4.862	4.733

Specific gravity with reference to water at 60° F. (vacuum)

Temp.	0°	20°	40°	60°	80°	100°	120°	140° F.
Value	0.6668	.6542	.6408	.6273	.6131	.5994	.5843	.5688

Vapor pressure p in lb/in^2 abs.

Temp.	−109.32°	23.7°	32°	70°	105° F.
Value	0.217	14.7	17.6	36.6	65.6

Rate of change of boiling point with pressure at the normal boiling point	1.528 (° F.) · (in. of mercury)$^{-1}$
Heat of vaporization at the normal boiling point	179.6 Btu.lb^{-1}

Some Physical Properties of Styrene

Alternative Names: Cinnamene, Phenylethylene, Styrol, and Vinylbenzene

(Metric System Units)

Property	Value	Source
Molecular weight of C_8H_8	104.144	–
Normal boiling point	145.2° C.	9
Freezing point	−30.60° C.	1

Density in g·ml^{-1}

Temp.	0°	20°	25°	40°	60°	80°	100°	120°	145° C.
Value	0.9240	.9056	.9010	.8873	.8689	.8506	.8322	.8138	.7909

Source: 10

Rate of change of density with temperature between 0° and 145° C.	−918 × 10^{-6} gm·l^{-1}·(° C.)$^{-1}$	10
Vapor pressure between −8° and +145° C.	$\log_{10} p = 7.2788 - \frac{1649.6}{t + 230}$	10

t in ° C.	0°	25°	100°	145.2° C.
p in mm. of mercury	1.28	6.45	166.0	762.4

Rate of change of boiling point with pressure at the normal boiling point	0.0487 (° C.)·(mm. of mercury)$^{-1}$	10
Heat of vaporization at normal boiling point	86.9 cal·g^{-1} 9040 cal·mole^{-1}	2
Heat of fusion	25.4 cal·g^{-1} 2645 cal·mole^{-1}	1
Specific heat at 25° C.	0.413 cal·g^{-1}·(° C.)$^{-1}$ 43.0 cal·mole^{-1}·(°C.)$^{-1}$	11
Refractive index for D-line at 25° C.	1.5443	10
Rate of change of refractive index with temperature between 17° and 26° C.	−560 × 10^{-6} (° C.)$^{-1}$	10
Surface tension at 19° C.	32.14 dynes·cm^{-1}	12
Limits of flame propagation in mixtures with air	1.1 to 6.1% (by volume) of styrene	13

(British Engineering Units)

Property	Value
Normal boiling point	293.4° F.
Freezing point	−23.08° F.

Apparent density in air in lb·gal^{-1} (U. S.)

Temp.	32°	60°	70°	105°	130°	293.4° F.
Value	7.702	7.582	7.540	7.392	7.285	6.590

Specific gravity with reference to water at 60° F. (vacuum)

Temp.	32°	60°	70°	105°	130°	293.4° F.
Value	0.9249	.9105	.9055	.8877	.8749	.7915

Vapor pressure p in lb/in^2 abs.

Temp.	32°	60°	70°	105°	130°	293.4° F.
Value	0.0247	.0704	.0787	.294	.583	14.74

Rate of change of boiling point with pressure at the normal boiling point	2.22 (° F.)·(in. of mercury)$^{-1}$
Heat of vaporization at the normal boiling point	116 Btu·lb^{-1}

Note—These tabulations were issued by the United States Department of Commerce, National Bureau of Standards, as Letter Circular LC-710.

Co. for making available its unpublished measurements of the density of liquid butadiene at different temperatures.

For the convenience of engineers accustomed to using the British engineering system, certain values are also given in the units of this system. They were obtained by conversion from the metric values given in the first part of each table.

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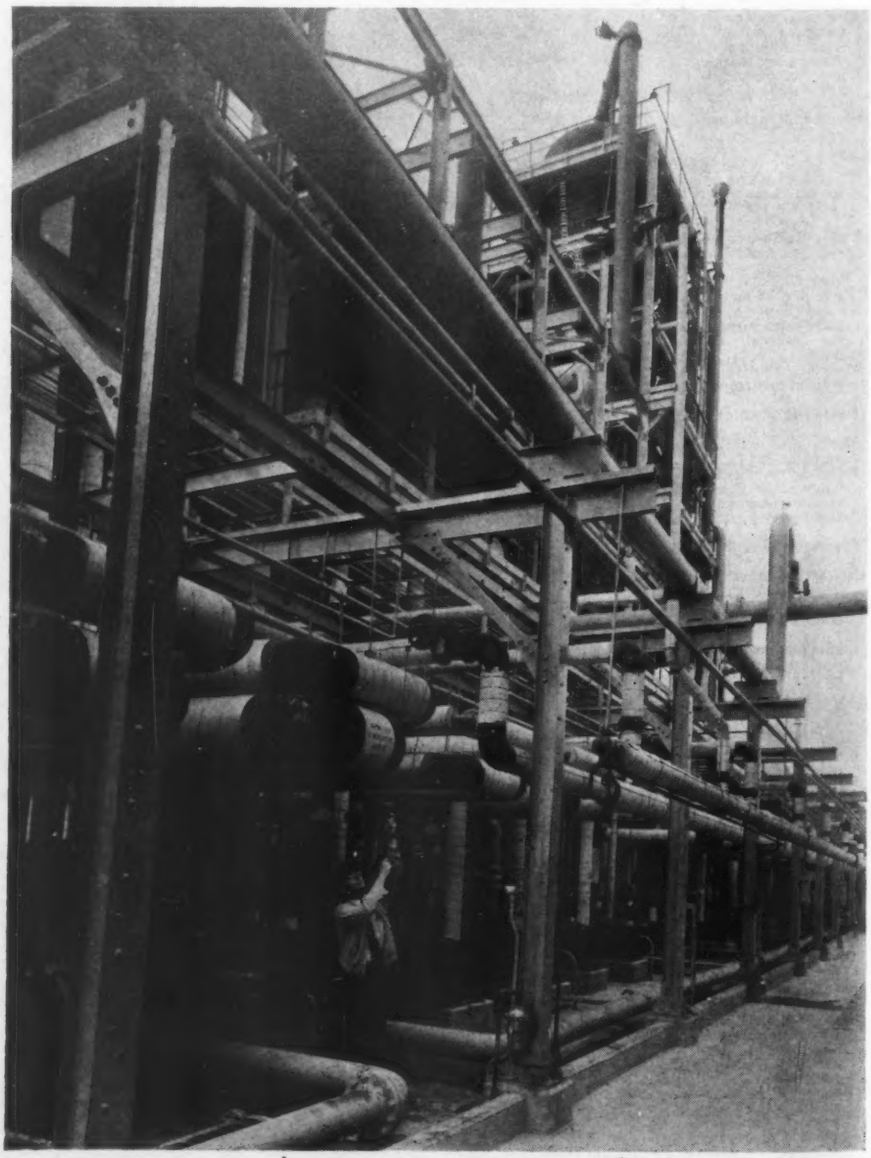
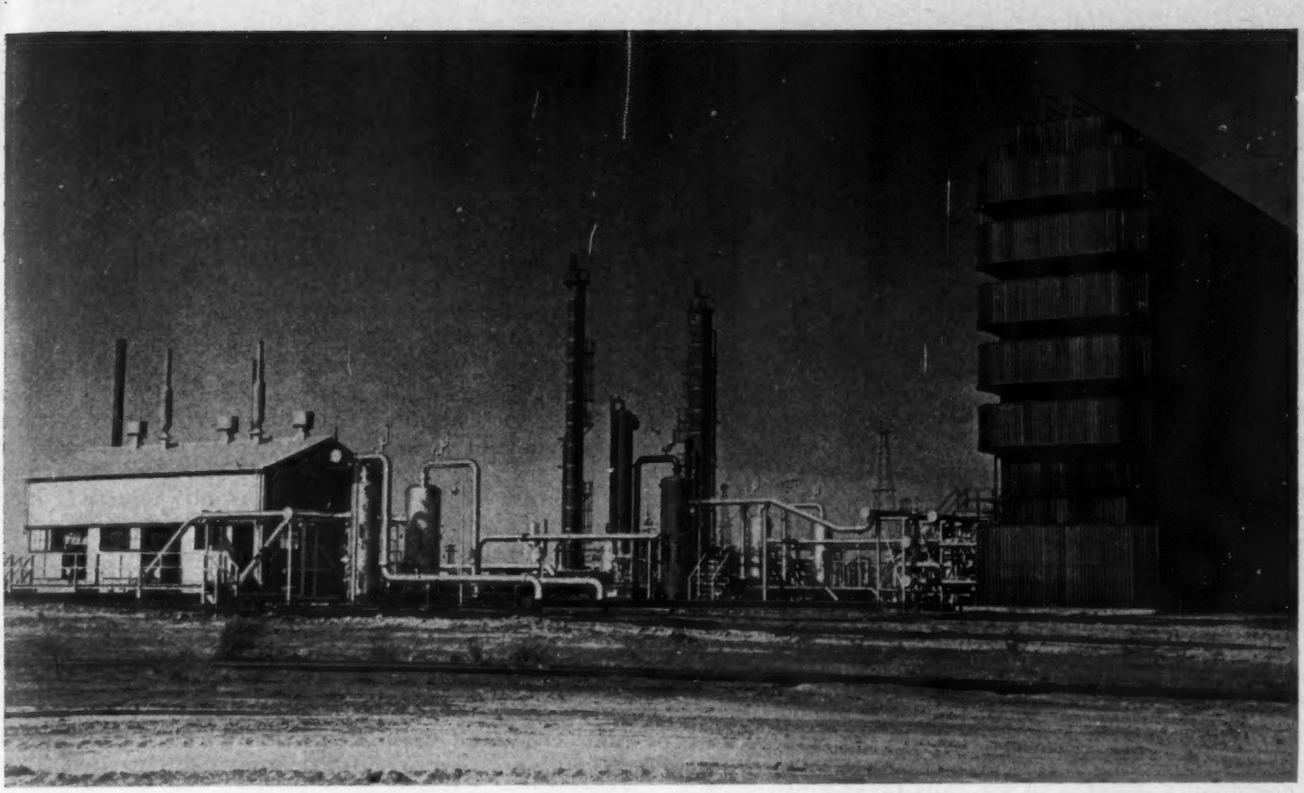


First butadiene unit for producing this synthetic rubber ingredient from petroleum under the program sponsored by the government is now on stream. It has capacity of 6600 or 9000 tons per year, depending on the quality of feed stock. In terms of tires this amount is sufficient for making rubber for 1,300,000 to 2,000,000 tires.

This unit was financed and under construction by Standard Oil Company of Louisiana, which intended to use its output in production of its own special types of synthetic rubber. Prior to Pearl Harbor, however, Rubber Reserve Company contracted for its entire output.

Its completion was scheduled for October, 1942, but shortages of materials caused delays which resulted in completion in January, 1943.



The Stabilization of Crude Oil

F. L. KALLAM, President, Industrial Engineers, Inc.

(Continued from February, 1943)

THIS installment concludes the review of a development which doubtless will play a vital part in conservation of petroleum. Although methods and equipment for crude-oil stabilization in the field are elementary, it is certain that refining engineers will continue to have a part in this approach to providing more choice hydrocarbons.

The method is simply one of not permitting lighter hydrocarbons to escape in the field. These "lighter ends," pentanes, propanes and butanes, are eagerly sought today since they are the raw materials for aviation motor fuels, synthetic-rubber ingredients and petro-chemicals.

One way of providing more of these hydrocarbons is to prevent their escape between the well head and refinery storage. Stabilization in the field will accomplish that.

In 1937, developments[49] in several fields of widely different characteristics indicated that the subject of crude-oil stabilization at the well, or at a central point in the field, was destined to become a subject of major importance. The evaporation of valuable fractions from crude oil from the time it is produced at the well until it is refined has always been a serious loss to the petroleum industry. The rapidly changing demand of the refiner for more of the lighter ends of the crude oil and the heavier fractions of the gas for processing in the new polymerization plants and in the manufacture of high-octane fuels, makes this evaporation loss more serious than ever.

Considerable progress has been made in saving these losses during recent years. This has resulted from the more judicious handling of the gas-oil mixture in the field, vapor-tight tankage, and "closed-system" pipe lines. Stabilization or vapor-recovery systems in the field are the most recent methods to control the usual losses. The widespread effect that would grow out of the extension of these latter practices would be felt in the producing, natural-gasoline, transportation, refining, and marketing divisions of the industry.

While it is not desired to raise any of the controversial issues incident to preheating of crude-oil mixtures before delivery to stock tanks, it is desired to present some of the details and data available from various types of vapor-recovery systems actually being used. It can be said, however, that both operating companies and state conservation authorities are looking with increased favor upon this practice when properly applied.

In the Tepetate field of Southern Louisiana, Continental Oil Company installed a combined crude-oil stabilization and absorption natural-gasoline plant which has done much to stimulate interest in the subject. This plant has adequate facilities to recover all vapors released from the high gravity gas-oil mixture due to reduced pressure and increased temperature.

E. O. Bennett and C. R. Williams[50] in a paper on

crude oil stabilization give an account of this Tepetate installation.[51, 52] They stressed the point that greatest ultimate economical yield of crude and natural gasoline can be realized only when all four parts of recovery operations are carried out simultaneously. These four components are production of oil and gas, stabilization of crude, extraction of natural gasoline, and return of residue gas to the producing formation. Proper control of all operations in a field must always be maintained for the satisfactory handling of production in the above cycle.

When oil of high gravity is produced by ordinary means through a separator into a lease gauge tank, the evaporation losses from reduced pressure and increased atmospheric temperature may be as much as 20 percent. This abnormal loss is caused from dissolved gases leaving the surface of the oil in the tank and carrying away appreciable quantities of valuable heavier fractions.

Stabilization may be classified as controlled evaporation in which all desirable fractions are caught and saved instead of being allowed to waste to the atmosphere. By stabilizing in the field, up to 50 percent of the products normally lost by evaporation may be recovered as salable products, the exact percentage being governed by local conditions.

At Tepetate, Continental Oil Company was fortunate in owning a complete structure, which it was possible to develop in an orderly and "planned-in-advance" manner. Initial formation pressure in this field was 3650 pounds. Oil produced from a formation with this pressure has much gas in solution and must be kept under pressure until it is stabilized to prevent losses.

The oil is produced through chokes ranging from 3/32- to 1/4-inch. The lines carry gas and oil to the lease separator battery, which is located at a central point inside the plant yard. A separator and a meter are provided for each lease. After metering, the oil is taken in a common stream to the stabilizer. Gas from each lease separator is likewise metered, and then flows through a single line to the 350-pound absorber of the gasoline plant.

The oil meters are arranged so that they can be tested for accuracy without placing their separators out of service. These meters are of the temperature-compensated displacement type, and read directly in barrels of oil at 60° F. The working pressure of the meters is 500 pounds, and they have been found accurate and suitable in all respects.

The high back-pressures used in producing this field indicated a long flow-life and dictated installation of a 500-pound well-pressure gasoline plant. This type permitted the use of a single gas-and-oil-gathering system instead of the dual arrangement required by the more conventional two-separator installation. The single pipe line for gathering the oil and gas saves approximately 40 percent of the investment cost of systems handling the oil and gas separately. It also permits use of a high-pressure absorption plant which can be constructed for approximately one third less than the conventional 40-pound plant.

The raw crude oil from the high-pressure separator is heated to 125° F., and flashed in a tank at 25 pounds pressure. The flashed vapors pass to a reabsorber with the resulting dry gas being utilized for plant fuel. Fat oil from the reabsorber joins the stream of corresponding oil from the 500-pound absorbers.

Crude oil from the flash tank is pumped at the rate of 4000 barrels per day into the stabilizer unit. Here the fractionating column is operated at 55-pounds pressure in order to remove all undesirable components as propane and lighter fractions. It is the purpose not to lower the vapor pressure of the crude oil beyond that normally produced as a result of natural weathering from lease tanks.

The dry gas from the high-pressure absorbers is used for field operations and some is sold as industrial fuel. The remaining dry gas is compressed to 3600 pounds for pressure-maintenance operation in field production.

Shortly after this installation was placed in operation, salt deposited in the heat exchangers and caused considerable trouble. This difficulty was overcome by introducing fresh water into the oil stream prior to entering the heat exchangers. The overall b.s. and w. content of the crude oil was not affected since the water added was just sufficient to equal that flashed out of the oil. The desirable low gas temperature in the high-pressure absorbers was produced by the refrigerating effect caused by expansion through the chokes at the producing wells. The casinghead pressures in this field are of the order of 2600 pounds.

Uncondensed vapors from the absorption plant and crude-oil stabilizer condensers are handled through a separate stabilizer unit. The product from this unit goes into the natural-gasoline storage tanks.

As a result of this stabilization operation, it was possible to blend all of the natural-gasoline production back into the stabilized crude oil, yielding an oil suitable for tanker shipment to the East Coast with very small weathering losses. The stabilized crude oil gravities varied from 34 to 69° API.

In the Rodessa field,[49] lease vapor-recovery systems have also been employed. They have proved successful in reducing evaporation and treating losses, and have materially increased the yield at gasoline plants. The gas in this field contains only small quantities of the heavier gasoline components, such as butanes and pentanes, so that stabilization equipment has been utilized largely for the recovery of light materials. These are the fractions which otherwise would be lost through storage or transmission weathering. Each installation has been an individual problem due to the varying manner of well completion and oil-gas ratio. Such installations generally consist of high- and low-pressure separators, the gas vented at the primary trap going direct to the fuel system. The high-pressure oil leaving this separator, together with any virgin low-pressure oil, is generally steam-heated to about 120° F., before entering the second, or low-pressure trap. Vapors liberated as a result of this heating and pressure reduction pass directly to the gasoline plant, the oil going to lease storage.

The large production volume, high-gravity crude oil and rich gasoline content in the oil-gas mixture has prompted many forms of field stabilization in East Texas.[49] The joint facilities of Hanlon-Buchanan, Inc., and Humble Oil & Refining Company, established a system together to gather, store, and transport the heavier gas components in a liquid form. This installation focused attention upon the economics which may be expected from stabilization of oil in the field. Up to the time of this installation, the inability to utilize the butanes and pentanes given off by local heat application at the traps constituted one of the greatest objections to the practice.

The application of heat to the oil before reaching the stock tanks in East Texas has been made for three purposes:

1. For separation of oil-water emulsion.
2. For removal of paraffin in lead lines, etc.
3. As an attempt to stabilize the crude oil.

In the latter case the removing and recovery of the light hydrocarbons by the application of heat was to forestall later losses due to weathering and those occurring during transportation of the oil.

Elevation of separators to permit operation at minimum pressures was almost universally used in this field by those operators equipped to recover the increasingly rich vapors resulting from the practice. The Texas Railroad Commission's ruling at the time on this practice was, "The application of any heat to crude petroleum oil before it is measured for allowable purposes is hereby prohibited except that heat may be applied to production from wells that are making the emulsion (b.s.) water, and oil, for the purpose of aiding in separating the emulsion, but in no event shall the heat applied be more than 140° F., or the pressure less than atmospheric."

A subsequent ruling was issued on the exact point of heat measurement, which stated, "—temperature shall be recorded at the point of separation of oil and gas, whether this separation occurs at the separator, gun barrel, or otherwise."

Approximately 10 percent of the East Texas wells produce water in an emulsified form with oil, and heated separators are almost universal due to the more rapid and complete separation as compared to gravitational systems. Many methods of applying heat to the oil-water mixture have been used, including a wide variety of efficiently manufactured treating systems. The practice indicates a direct relation between trap pressure and stock-tank vapors, establishing the fact that the lowest practical pressure will result in the greatest vapor recovery to the gas system, with the minimum vapor remaining in the oil to be lost by evaporation.

Following the contention that some serious losses were being recorded by pipe-line companies from the point of storage in the field to the delivery point on the Gulf Coast, tests were made to determine actual losses in this respect. Some of these losses were reported as high as 2° API gravity, but later tests indicated a maximum loss of about 0.5° API.

1938

In 1938 it was stated[53] that conservation of gravity in the production and handling of oil not only effects a saving of volatile portions, but also of volume.

Schmidt[54] conservatively estimated that the losses from well to refinery had been cut from 6.2 percent in 1921 to approximately 2 percent in 1934. It was concluded by the writers[53] that this figure was entirely too small for 1934 and even for 1938, since on many leases, by attention to treating and storage, it was possible to save more than 2 percent by volume. It was assumed that more than 50 percent of these losses occurred on leases where the gravity affected price, with an estimated evaporation loss of 0.4° API in gravity. This means that probably one third of the production is changed to a lower gravity bracket, thereby losing something like 2 cents per barrel in price.

This estimated value does not actually represent true loss, as the portions evaporated are mainly gasoline fractions which are more valuable than the average price for the crude oil indicates. Also, additional material losses occur with certain methods of production, such as gas lift or production with high gas-oil ratios.

Schmidt[54] was further quoted as saying that lease losses could be cut 1 percent by using properly maintained and efficiently operated tankage. Actually, only 50 percent of the decrease in evaporation is realized by operators because of poor use of the provided equipment. The recognition of these losses and application of common-sense methods can result in economic savings, as generally the first cost is the last cost in much of the gravity conservation work.

As previously mentioned, certain methods have a direct or indirect effect on the gravity of the produced oil. In some instances losses caused by the production methods are partly recovered in gasoline plants. But according to these writers, considering the cost of such recovery, the nearness of the sale price of natural gasoline to crude oil, the increased transportation cost for the gasoline and the greater evaporation loss occurring in the more volatile fluid, it is generally more profitable to retain as much gravity, with consequent connected volume, in the crude as possible.

The methods used for treating probably have a greater effect on gravity loss than any other phase of oil production. Many obsolete and unscientific methods for treating oil are still carried on. The use of treating systems that are gas tight have resulted in the largest retention of gravity in the oil, all other conditions being equal. This is particularly true on systems where pressure can be maintained and heat exchangers used to cool the oil to atmospheric temperature before it goes to storage. Such units have the further advantage in that they dispense with the use of separators, and permit the gasoline plant to secure the rich vapors evolved in treating.

The value of vapor-tight tanks alone in reducing storage evaporation loss is well shown by tests given by Wiggins[33]. The logical tanks for lease storage were shown to be of the welded type where the size of production does not make their use unfeasible. The smallest possible vapor-tight tanks should always be used. Painting of lease tanks with light colors has a material effect on the gravity of the oil delivered to the pipe line.

Pipe-line losses are principally incurred by air that has been allowed to enter gravity gathering systems and then later is expelled with its load of vapors at the pumping stations. Another loss in pipe-line transportation is the filling loss occasioned in filling cone-roof working tanks. These losses can be prevented by the introduction of floating-roof tanks.

The writers concluded that a great many things may be done to conserve gravity, with its consequent saving of volume. Knowledge of most of these moves is general. However, it is apparent that many producers do not follow the best-known practices, particularly during periods of flush production.

1939

Gibson[55] states that a process known locally as multi-stage stabilization has been developed in the Haft Kel field of Southwest Iran by Anglo-Iranian Oil Company. This process was installed principally to recover natural gasoline. It consists of releasing the dissolved gases from the crude oil by stages, a practice which is now common in many fields, but as far as known, has not been elsewhere carried to the extent to which it is employed in Iran.

With full freedom of selection, the first-stage sep-

aration at Haft Kel would be conducted in the region of 750 pounds. The flowing pressures of the majority of wells lie between 500 and 600 pounds at a constant temperature of 105° F. Therefore, the first-stage separation is actually carried out in separators located as closely as possible to the well heads in order to obtain the highest possible pressure. The use of 6 stages of separation helps to counterbalance the loss in efficiency that results from the lower initial-stage pressures.

Provision is made in pipe-line stations and at the terminal refinery to deal with vapor pressures of nearly 30 pounds in order to take care of fluctuations in temperature between night and day.

The normal gas-oil ratio of Haft Kel crude oil single flashed into flow tanks at atmospheric pressure is approximately 468-cubic feet per barrel. Treatment of this gas from the flow tanks by compression to 250 pounds yielded a recovery of 2.5 gallons of gasoline per 1000 cubic feet.

By reducing this same oil in 6 stages to atmospheric pressure the released gas was reduced to 368 cubic feet per barrel of oil. The separations are made at 500-, 313-, 87-, 40-, 19-, and 10-pounds pressure.

1940

In 1940 the following discussion was given of crude oil stabilization[56]. Many oil fields, particularly those outside the United States, are located thousands of miles from the refineries in which the ultimate processing takes place. By stabilizing the oil in the field, and eliminating hydrogen sulphide at the same time, evaporation losses are avoided and the life of pipe lines, tankers, and refinery equipment is increased.

In certain circumstances it may prove feasible and economical to conduct all of the oil and dissolved gas at well-head pressure directly to the stabilizer. In other instances, calculation based on fundamental analysis of the gas and oil may show that a partial reduction in an intermediate let-down-pressure system between the well and stabilizer is desirable. This latter arrangement may permit loss of the heavier and desirable constituents of the crude oil.

This source of information further states that four units are in commercial operation having a total crude oil charging capacity of 200,000 barrels per day. These units are capable of reducing the vapor pressure of the oil from 80 to 5 pounds while simultaneously reducing the hydrogen sulphide content from 0.4 to 0.0008 percent. At the same time, more than 95 percent of the butanes and heavier materials are retained in the stabilized oil.

A second article[57] gives a discussion of stabilizing plants patterned after that of Bennett[50] and Smith[58].

It is pointed out that normal Mid-Continent crude oil contains 0.2 to 1.3 percent propane and 3.5 to 6.5 percent butanes, and that more than half of the total amount of these two hydrocarbons can easily be retained in a stable oil product. If the oil is not stabilized, nearly all of this propane and butanes may be lost. Crude oils that are produced under extreme pressures are even richer in volatile hydrocarbons and even greater losses occur. Now that butane is being utilized as a charging stock for polymerization plants, it is becoming increasingly important to stabilize the crude oil. Such a process is probably not economically feasible unless fuel costs are low.

1941

Republic Production Company, in Joe's Field, Tyler County, Texas, produces 18—20,000 gallons per day of natural gasoline, and stabilizes the crude oil produced[59]. The principal function of this installation is the pressure maintenance of the producing formation in the area.

This plant processes 4,000,000 cubic feet of gas from 45 oil wells and an additional 2,000,000 cubic feet from 3 gas wells. The latter gas is used only in pressure maintenance since it contains no commercial gasoline fractions.

Oil wells in this field are produced from an approximate depth of 7700 feet, with tubing pressures of the order of 1200 pounds and well-head pressures of about 1600 pounds. The dry gas is returned to the sands both through the casing and tubing of a single key injection well at a pressure of 2700 pounds.

Crude oil is taken into the plant through a 130-pound conventional trap where a portion of the gas is removed. The oil next enters two small treaters where the temperature is raised sufficiently to eliminate water that might be present. After dehydration, the oil flows to the upper chambers of a two-compartment tank. Pressure on the upper chamber is held at 25 pounds, and in the lower compartment, into which the oil next flows, at atmospheric pressure or slightly lower. Gas is released from both compartments, and the resulting so-called stabilized oil is removed from the lower vacuum compartment and delivered to the field storage tanks.

The vacuum gas is compressed and introduced into the gas issuing from the upper compartment, after which the mixture is again raised in pressure and mixed with the gas released from the 130-pound-initial plant separator. A third stage of compression makes the combined gas available at a pressure of 350 pounds. A second 300-horsepower machine then compresses the gas in two stages to 2700 pounds pressure.

The dry gas from the 3 non-oil producing wells, at 800 pounds pressure, is handled in a third compressor unit which discharges it into the 2700-pound gas. This combined high-pressure gas is then injected into the oil-producing formations.

The gasoline condensates from all of the compressor inter-and after-cooler accumulators are collected and processed in a stabilizer. This unit is operated so as to produce a 26-pound-Reid-vapor-pressure product. The stabilized gasoline is shipped by introduction into the crude oil line.

Likewise in 1941, Richfield Oil Corporation[60] installed a so-called crude-oil field stabilizer on its Richfield-Western property in the San Joaquin Valley. This unit consists of a special fractionating column for removing the propane and lighter fractions from the crude oil. This is done in the field in order to reduce flash evaporation losses and thereby retain the iso- and normal butane fractions in the oil. Actually, this is accomplished by continuously taking off a 10-percent cut from the oil in a conventional topping unit. The light portion of the oil removed in this fashion is then stabilized in the usual way, removing all propane and lighter materials as an overhead vent and concentrating the butane fractions in the bottoms. After this fractionation, the stabilized bottoms are blended back with the topped crude, the combination forming pipe-line oil.

Glasgow, in a discussion[61] of gravity losses in the production and handling of crude oil, states that with

each passing year the oil industry is becoming more conscious of the importance of conservation. This is primarily due to a better knowledge of production practices, proration, and other regulating measures, national defense, and a more comprehensive understanding of the ultimate financial gain resulting from cooperative methods of conservation.

The prevention of gravity losses from crude oil is one of the many phases of true conservation, and one that is still neglected, although not quite to the same extent as in the past. Its importance is far reaching since crude-oil hydrocarbons, once released to the atmosphere, can never be recovered.

For example, a tank containing 1000 barrels of oil shrinks to 975 barrels when the gravity is lowered 1° API. This means that 25 barrels of oil evaporated into the atmosphere and can never be recovered. Assuming oil to be worth $1.00 per barrel, and a 2-cent-per-barrel deduction for a change to a lower-gravity price bracket, the loss per year in the United States would be $32,640,000.00, based on a daily production of 3,500,000 barrels. Gravity losses are therefore important to the entire oil industry and to the nation as well, since such losses represent a dissipation of natural resources.

It should be emphasized that the only way that a crude oil can lose gravity is by evaporation. Preventing vaporization therefor prevents loss of gravity.

Generally, the only points in the production system of oil where vaporization can occur are as follows:

1. Separators or traps.
2. Treating equipment when used.
3. Field or lease stock tanks.
4. Pipe-line storage.

It was again stated that oil produced at high pressure should be stage separated at graduated decreased pressures in order to produce a stable oil in the stock tanks. Two, or even three stages, were said to be the most economical practice. It was pointed out that more stages would produce a higher gravity oil in the tanks, but not enough higher to warrant the additional initial investment.

In most cases, it was thought desirable to treat or dehydrate the oil at as low a temperature as possible to prevent gravity loss unless some means of stabilization was provided in the treating system. Under the latter conditions, a slight increase in treating temperature will produce a more stable oil to the stock tanks.

It was further suggested that lease storage should always be equipped with thief hatches and stock valves to permit holding at least eight ounces of pressure on such tanks. Further, these tanks should also be covered with aluminum paint in order to reduce the temperature and thus lower evaporation loss to a minimum. Another important step recommended was the use of welded tanks of small diameter, which reduces the oil surface area for vaporization.

The general conclusion was drawn that the most important phase of preventing gravity loss in all types of stock tanks is to produce into these tanks a low temperature stable oil. This means oil that is free of unstable light fractions that have the tendency to cause loss of the heavier and desirable hydrocarbons. Therefore, if oil can be produced into stock tanks at approximately atmospheric temperature, and which is stable at this temperature and pressure within the tank, gravity losses will be reduced to the minimum.

An unusual system of production which has functioned satisfactorily for nearly two years was described in a 1941 technical journal[60, 62]. This system, located in the Damman Field of Arabia, consists of individual flow lines from each well to a central gas-trap setting. From these traps, the oil flows to a stabilizer unit, after which the rectified oil is placed in the field storage tanks.

The wells in this field have a shut-in head pressure of 850 to 900 pounds, and are produced to give something less than 100 pounds draw-down. Individual flow lines are laid at the ground surface, some being as long as three miles, and connect the wells with the trap battery. These flow lines were used for gas fuel supply to the rigs during the drilling period.

Adjustable chokes are placed in these flow lines at the trap setting, making it possible for one operator to change the production rate of any or all wells, or to close in the wells, by merely adjusting the "trap" chokes. After the chokes, the oil can be manifolded from any particular well, or it can be completely isolated from that of the other wells.

The central trap battery consists of four sections, each of which consists of four 30-inch diameter 500-pound traps, one 36-inch and one 60-inch 125-pound traps. Pressures in two stages of gas separation are usually conducted at 160 pounds and 50 pounds. Orifice meters measure the gas separated, and this gas is piped to a common vertical riser and burned.

From the central trap setting the oil moves through ten- and 6-inch lines to the stabilizer plant. On the smaller of these lines is a by-pass arrangement to a 100-barrel closed surge tank, designed for 50-pounds working pressure, and equipped with sight glasses and gauging column. This tank is further supplied with quick-opening valves at the points of entrance and exit. When a production gauge of an individual well is required, the flow from this well is diverted through separate gas traps and into the surge tank. The filling-up rate is timed and from the gauge column the production rate determined. These "flash" gauges have been found to correspond within 1 percent of the conventional tank gaugings. As the oil and gas from this field contains appreciable quantities of hydrogen sulphide, this closed system of individual well gauging is important as a safety measure.

The stabilizer unit is of conventional design and removes as an overhead product the H_2S and "wild" gas from the oil. These products are wasted by burning as a flare. The stabilized and "sweetened" oil from the base of the stabilizer column flows into the lease storage tanks.

This type of system therefore allows for complete control of the flow rates from all wells in a field from a single location. It further provides a closed circuit from the wells to the field tanks that includes gas separation, individual well gauging, stabilization and H_2S removal.

1942

In 1942, Gruse and Stevens[63] state that the term stabilization refers to the removal by distillation of light hydrocarbons, such as propane and butanes, which cause an undesirably high vapor pressure. The process is said to be more common for gasolines, but has been applied to crude oils in order to facilitate storage and handling, or, as a first step in complete distillation. When used on crude oil the installations seldom have a charging rate of less than 10,000 barrels per day. It is stated that such operations are always continuous and conducted at relatively low

pressures of 50 to 75 pounds and temperatures of the order of 300° F. Emphasis is also placed on the fact that the distillate from such an operation is a very light gasoline, usually consisting of 90 percent pentanes and lighter fractions. Before such gasoline can be employed for controlled-blending purposes it in turn must likewise be stabilized and freed of the lightest and undesirable materials.

Conclusions

It is obvious that crude-oil stabilization has made some progress during the past 16 years, but the record indicates that the oil industry has yet failed to fully grasp the economic possibilities of the process. This is to say, that complete understanding is still lacking as to the benefit resulting from controlled evaporation brought about by means of fractionation. It is paramount to first realize that only through fractionation is it possible to remove from the oil the light undesirable fractions and still retain all of the heavier and desirable constituents.

In accomplishing this retention by fractionation it is usually possible to increase both the volume and the gravity of the oil sold without increasing the evaporation tendency in the lease tanks. This follows from the fact that in controlled removal of the light hydrocarbons, the percentage of the remaining heavier fractions can be increased without disturbing or changing the value of the vapor pressure of the original oil.

One reason for the general failure to accept and utilize this fact is the generally divided responsibility occurring in the production of oil. The producing department is primarily concerned with bringing the oil to the surface and possibly considers the accompanying gas as a necessary evil to be handled by others. The department charged with processing the gas in turn naturally considers their operation of prime importance, and is not too much concerned about the actual oil production. Primarily, this lack of teamwork is chargeable to faulty management, whose function it is to secure the greatest possible economic return from the company's overall operation. Crude-oil stabilization can only be successful and beneficial when the production of both oil, gas, and natural gasoline are jointly and fairly considered. It is therefore up to management to see that this joint problem is attached and solved in a rational manner.

The problem of whether or not to stabilize the crude oil calls for very careful engineering study, with the overall interests of the company kept foremost in mind. It is apparent that the subject of oil and gas separation is not one to be decided by any one department or individual, but rather by its relationship and importance to the entire project of oil and gas production. Every problem of crude-oil stabilization must be solved for the particular oil and gas characteristics of the field considered. The question of temperatures and pressures of separation are involved to say the least, and are further complicated by the allied subject of stages to be employed. The final selection will be governed by the field conditions, methods of production and the physical characteristics of the oil and gas. About the only generalization possible is that one separation should be conducted at the highest optimum pressure. This will permit economic venting of the ethane and lighter materials from the oil with the minimum loss of desirable and valuable hydrocarbons.

The actual mechanics of the design of the stabilizer unit itself will in general offer little difficulty in view of present-day knowledge. Knowing the feed stock to be processed and the allowable vapor pressure of the desired product, the operating conditions for the unit can be determined. In so doing, consideration must be given the available heating and cooling facilities. Usually in most installations, a wide choice exists as to these various details, thereby permitting the stabilizing unit to be "tailor-made" to best fit the existing or predicted field conditions.

Under certain field conditions, the installation of a crude-oil stabilizer unit can be arranged to eliminate the necessity of a natural-gasoline plant. In most cases, however, the crude-oil stabilizer will fit conveniently into an existing operation involving the conventional gasoline plant. It should always be remembered that one of the advantages of the crude-oil stabilizer is that it results in the saving of gas-compressor capacity. This results from the fact that vapors removed from the crude oil in the stabilizer are made available at a higher pressure than would be the case if they were released in the ordinary low-pressure trap or at the lease tanks.

Producing stabilized oil into lease tanks does away with weathering losses and automatically eliminates the need for any form of vapor-recovery system. Similar savings will result at all tank farms and in handling through the pipe line and the refinery.

In fields where the oil production is accompanied by hydrogen sulphide, the crude-oil stabilizer will serve as an excellent scrubber and economic remover of this corrosive agent. Likewise, by adequate design, the stabilizer can lend itself to the problem of dehydration of the oil and the removal of salts and other sediments.

It is the writer's concluding opinion that crude-oil stabilization can be adapted to many of our domestic fields in sizes commensurate with the local conditions. Fundamentally, no issue can be taken with a process which cures evaporation loss at the source and makes unnecessary the subsequent recovery of such losses in order to prevent economic waste. In all new fields, and in many of the existing fields, the system of crude-oil stabilization should be carefully considered in view of its possibilities for greater efficiency and economy in conservng our petroleum resources.

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AIMME Focuses Attention on Economics of Petroleum

ECONOMIC and technical developments within the petroleum industry were discussed in detail at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York, February 15, 16, 17 and 18. Papers from the petroleum division which have application to economics and developments of refining are presented in this issue of PETROLEUM REFINER.

Champion Herbert Mathewson, professor of metallurgy, Hammond Laboratories, Yale University, was elected president.

Charles A. Warner, a director of the Houston Oil Company, Houston, was chosen chairman of the petroleum division.

The Lucas Medal, awarded annually for achievement in petroleum engineering, went to John R. Suman, vice president of Humble Oil & Refining Company, Houston.

The three associate chairmen of the petroleum division for the coming year are: Carl E. Reistle, Jr., chief petroleum engineer, Humble Oil & Refining Company, Houston; Cresap P. Watson, vice president, Seaboard Oil Company, Los Angeles; and Basil B. Zavoico, geologist, department of petroleum economics, Chase National Bank, New York.

Harold Vance, head of the petroleum engineering department of the Agricultural and Mechanical College of Texas, College Station, will continue as secretary-treasurer.

C. A. Warner will serve as chairman of the executive committee, as well as chairman of the petroleum division, and the five other members of the executive committee will be as follows: M. L. Haider, petroleum engineer, Standard Oil Development Company, New York; William B. Heroy, petroleum engineer, Washington, D. C.; Winfield S. Morris, petroleum engineer, field chairman of the East Texas Engineering Association, Kilgore, Texas; Eugene A. Stephenson, professor of petroleum engineering, University of Kansas, Lawrence, Kansas; and Harry P. Stolz, mining and petroleum engineer and commander in the U. S. N. R.

Chairman of standing committees of the petroleum division for 1943 include the following: for production engineering, Lawrence E. Porter, assistant manager, exploitation, Richfield Oil Company, Los Angeles; for production, Winthrop P. Haynes, geologist, Standard Oil Company of New Jersey, New York. Assisting Haynes will be two associate chairmen for production: Lewis W. MacNaughton, consulting petroleum geologist, DeGolyer, MacNaughton & McGhee, Dallas, Texas; and Lyon F. Terry, second vice president, Chase National Bank, New York.

Everett G. Trostel will serve as chairman of the standing committee for engineering research. He is conservation engineer, Office of Petroleum Administrator for War, Los Angeles. Chairman of the standing committee for economics is Norman D. Fitzgerald, engineering economist, Great Lakes Carbon Corporation, New York. Walter Miller, vice president, Continental Oil Company, Ponca City, Oklahoma, is chairman of the committee for refinery engineering. For membership, the committee chairman is James McKean Bugbee, petroleum engineer and geologist, Baroid Sales Division, National Lead Company, Houston. Donald L. Katz, assistant professor of chemical engineering at the University of Michigan, Ann Arbor, will head the committee for papers and program, and Thomas A. Atkinson, production engineer, General Petroleum Corporation, Los Angeles, will serve as associate chairman of the papers and program committee.

L. W. Blau, in charge of geophysics and production research for Humble Oil & Refining Company, Houston, will serve in 1943 as chairman of the geophysics committee. F. B. Plummer, professor of geology and in the Bureau of Economic Geology at the University of Texas, Austin, has been chosen chairman of the committee on production of geology.

Capital Flow and Capital Formation in the Petroleum Industry, 1934-1941

BY JOSEPH E. POGUE and FREDERICK G. COQUERON, *Department of Petroleum Economics, The Chase National Bank, New York*

This paper shows flow of capital in the petroleum industry for 8 years, 1934-1941, outlining its movements into the various divisions of the business, the sources from which capital was derived, and final investment subdivided by functions. The analysis is based on combined information on 30 oil companies, representative of the industry as a whole. The 30 companies in 1941 produced 52.5 percent of the domestic output of crude petroleum and ran to stills 79.9 percent of the crude oil processed; and in 1938 sold 85.1 percent of the gasoline consumed in the United States.

Rate of Return on Invested Capital of 29 Oil Companies Versus Group of Over 1100 Manufacturing Companies, by Years, 1934-1941

(Percent)

YEAR	29 Oil Companies	Over 1100 Manufacturing Companies	Difference
1934	2.9	4.3	−1.4
1935	4.9	6.7	−1 8
1936	7.7	10.4	−2.7
1937	10.1	10.8	−0.7
1938	5.1	4.8	+0.3
1939	5.4	8.5	−3.1
1940	6.3	10.3	−4.0
1941	8.8	12.4	−3.6
Average	6.4	8.7	−2.3

Outstanding conclusion to be drawn from the study is that the petroleum industry in the 8 years preceding the United States entry in the war was financially self-reliant, providing for its growth practically entirely from capital charges and net profits.

Data in the paper also should prove useful to oil companies as norms against which to measure individual performance and divergence.

Aside from constituting an economic and accounting record, the financial data presented in the paper form the basis for the drawing of several broad conclusions by the authors, as follows:

1. The petroleum industry generated the capital necessary for its maintenance and expansion, thus constituting a self-reliant industry.

2. The net increase in debt was very modest and the existing ratio of debt to other forms of capital is conservative.

3. Investments in fixed capital assets increased in importance between 1934 and 1941, and current assets became less important in relationship to borrowed and invested capital.

4. Nearly two thirds of the capital invested went into the producing branch of the industry, indicating the high cost of replacing and increasing crude-oil reserves.

5. The efficiency of capital utilization is indicated by the fact that the 30 oil companies under review increased their crude-oil production by 55 percent and their runs to stills by 52 percent between 1934 and 1941 as compared with a net expansion of 23 percent in gross fixed capital assets.

6. The gross investment in fixed capital assets of 30 oil companies on December 31, 1941, was $10,173,000,000, divided as follows: production 49.0 percent, transportation 15.2 percent, refining 18.7 percent, marketing 15.1 percent, and all other 2.0 percent.

7. The flow of funds exhibited cyclical variations, expenditures for capital investments fluctuating with changes in the price of crude oil.

8. The return on invested capital for 29 oil companies for 8 years averaged 6.4 percent, against 8.7 percent for a group of over 1100 manufacturing companies.

9. The consolidated statements here submitted point to an oil economy functioning soundly and effectively.

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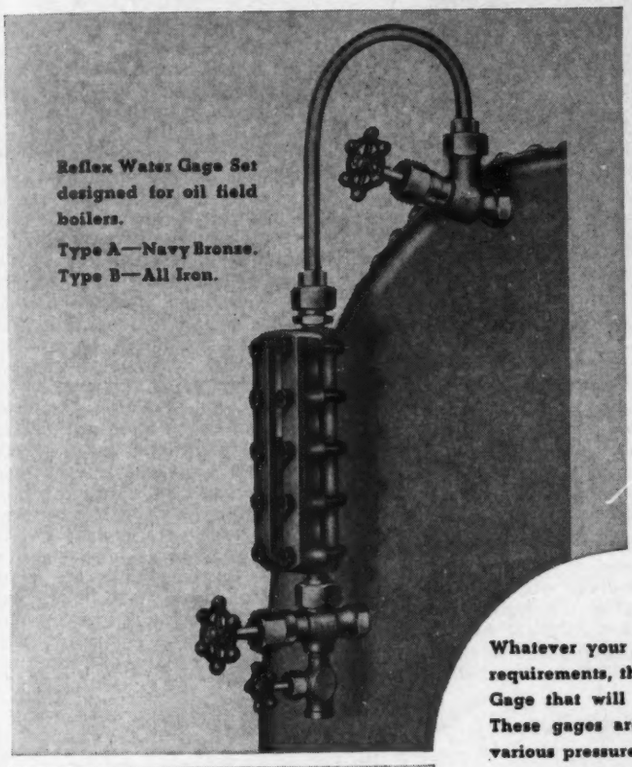

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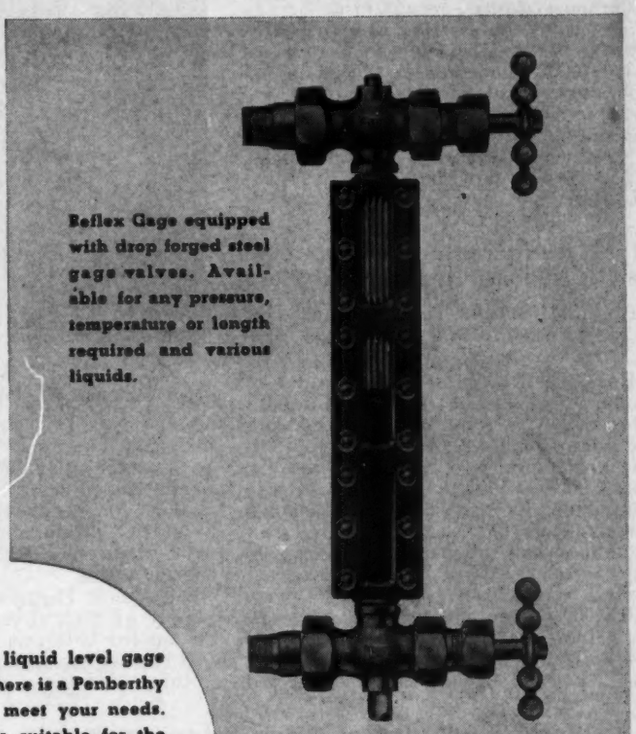

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that capital, $3,874,000,000, or 73 percent, was derived from "capital extinguishments," that is, deductions from income set aside as return of capital and therefore available for reinvestment. The industry came remarkably close to supporting itself capitalwise. The 30 companies in 8 years reported net income of $2,925,000,000, which with the addition of $3,874,000,000 for capital extinguishments and $160,000,000 for other charges indicates a total cash production of $6,959,000,000 dollars, sufficient to support capital expenditures of $5,275,000,000, and dividends of $1,617,000,000, with a margin left over of $67,000,000. Dividends for the whole period represented 55 percent of net income—a very conservative proportion—and only 23 percent of cash production. Out of every dollar of cash produced, 77 cents was ploughed back into the business.

World Consumption of Petroleum and Its Substitutes During 1942

By V. R. Garfias, R. V. Whetsel, and J. W. Ristori, *Cities Service Oil Company*

Rough estimates of world output of crude petroleum and petroleum substitutes reflect to some extent world consumption. Such estimates for 1942 indicate production of 2,208,000,000 barrels, or 171,000,000 less than in 1941. Crude production decreased about 200,000,000 barrels (9 percent), while estimated production of substitutes increased 28,500,000 barrels (nearly 20 percent). In the United States crude output was down 19,000,000 barrels (less than 2 percent), while that in foreign countries declined about 180,000,000 barrels (over 20 percent). Marked decline abroad reflected losses in Venezuela and Columbia, due to shortage of tankers, and in the East Indies and Burma, due to military invasion and destruction of properties. Indicated production of substitutes in 1942 was a new high of 7½ percent of world output.

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Important changes have occurred in supply of Axis countries. In Japan the output for 1941 was estimated at 8,800,000 barrels, of which 5,500,000 was substitutes. Synthetic production probably increased in 1942 and raised total interior production to 10,000,000 barrels, while the Japanese gained possession of oil fields having normal peacetime output of 78,000,000 barrels annually. Production of those areas for 1942 is estimated at 23,000,000 barrels, indicating Japan now gets at least 33,000,000 barrels a year, or 8,000,000 barrels more than peak peacetime consumption. Holding of Dutch East Indies and Burma fields would leave Japan no difficulty on sources of supply, and greatest problem would be ocean transportation and to some extent refining equipment.

Total output for 1942 for European Axis countries and controlled areas was about 112,000,000 barrels—up 20 percent from 1941. Germany is steadily increasing synthetic-oil production, many reliable sources report, the estimates averaging 46,000,000 barrels for 1942 and indicating nearly half of the present supply as being substitutes. This may indicate ineffectiveness of bombing of synthetic plants or concealment of the widely distributed plants from aerial attack. But Rumanian production is 35 percent of European Axis output, and being confined to small area, leaves Germany vulnerable to heavy loss of supply by continuous bombing. An average of European Axis consumption estimates is 13,000,000 barrels per month during active military operations and 9,000,000 monthly between campaigns. This indicates that small accumulations are possible when military operations are passive but that reserve oil stocks shrink considerably when operations are active. Nevertheless, difference between petroleum supply and demand for European Axis powers cannot be great, and extensive efforts are justified toward destruction of Axis sources of supply wherever they can be found.

World Production of Crude Petroleum and Its Substitutes

(Thousands of Barrels)

COUNTRIES	1941			1942 (Estimated)		
	Crude	Petroleum Substitutes	Total	Crude	Petroleum Substitutes	Total
The World:						
U. S. A.	1,404,180	67,680	1,471,860	1,385,000	79,000	1,464,000
U. S. S. R.	240,000	1,500	241,500	212,000	2,000	214,000
Venezuela	223,000	1,200	224,200	145,000	1,500	146,500
Iran	78,000	1,000	79,000	76,000	1,000	77,000
Netherlands India	62,120	1,000	63,120	9,000	200	9,200
Mexico	41,200	1,000	42,200	35,000	800	35,800
Rumania	40,500	2,000	42,500	41,000	2,000	43,000
Germany	5,240	32,000	37,240	5,400	46,000	51,400
Colombia	24,400	900	25,300	10,600	900	11,500
Argentina	21,800	500	22,300	22,000	600	22,600
Trinidad	21,200	200	21,400	24,500	200	24,700
Peru	12,900	1,000	13,900	13,500	1,000	14,500
Canada	6,300	3,700	10,000	6,400	3,900	10,300
Iraq	12,500	.....	12,500	14,800	.....	14,800
Japan	3,300	5,500	8,800	3,400	6,900	10,300
Egypt	7,700	200	7,900	8,000	300	8,300
Burma	7,800	100	7,900	2,400	100	2,500
Bahrein Island	6,900	200	7,100	7,800	200	8,000
United Kingdom	.....	7,000	7,000	.....	7,500	7,500
Sarawak	1,340	.....	1,340	500	.....	500
Brunei	5,460	.....	5,460	1,000	.....	1,000
Saudi Arabia	5,870	.....	5,870	6,000	.....	6,000
France	500	4,100	4,600	500	4,800	5,300
Poland	3,310	200	3,510	3,400	300	3,700
British India	2,270	.....	2,270	2,500	.....	2,500
Hungary	2,600	100	2,700	3,800	200	4,000
Ecuador	1,500	50	1,550	1,800	100	1,900
Italy-Albania	1,200	300	1,500	1,500	400	1,900
Miscellaneous	700	4,200	4,900	800	4,300	5,100
Total, World	2,243,790	135,630	2,379,420	2,043,600	164,200	2,207,800
European Axis Powers:						
Rumania	40,500	2,000	42,500	41,000	2,000	43,000
Germany	5,240	32,000	37,240	5,400	46,000	51,400
France	500	4,100	4,600	500	4,800	5,300
Poland	3,310	200	3,510	3,400	300	3,700
Hungary	2,600	100	2,700	3,800	200	4,000
Italy-Albania	1,200	300	1,500	1,500	400	1,900
Miscellaneous	200	2,000	2,200	200	2,100	2,300
Total, European Axis Powers	53,550	40,700	94,250	55,800	55,800	111,600

Viscosity of Natural Gases

By Leo B. Bicher, Jr., and Donald L. Katz, *University of Michigan*

This paper presents a correlation for predicting viscosities of light paraffin hydrocarbon mixtures such as natural gases for temperatures from 0 to 400° F. and for pressures from atmospheric to 10,000 pounds per square inch. The correlation is based on the viscosity data for the methane-propane system and only requires a knowledge of the molecular weight of the natural gas. Viscosities of natural gases reported in the literature up to 2500 pounds were reproduced by the correlation with an average deviation of 5.8 percent.

Viscosity of a natural gas is required whenever calculations are made of the pressure drop which occurs while the gas flows through pipes or porous media. Methods of predicting the viscosities of gases at the present operating pressures are not available. This paper presents a simple method of predicting the viscosity of a natural gas in the single phase region from its molecular weight, temperature, and pressure.

Viscosity of methane, propane, and four of their binary mixtures, 20, 40, 60, and 80 mol percent, have been determined for pressures from 400 to 5000 pounds per square inch and temperatures from 77 to 437° F. with an experimental accuracy of 3.2 percent. Apparatus used in the investigation consisted of a rolling-ball-inclined-tube-type viscosimeter with auxiliary equipment for making up

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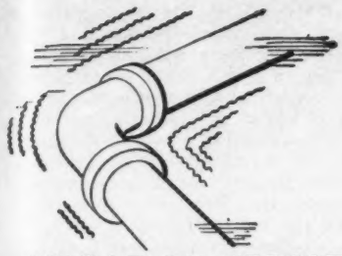
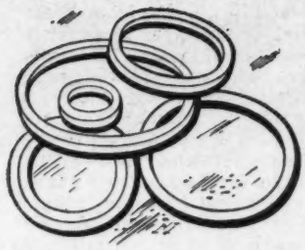


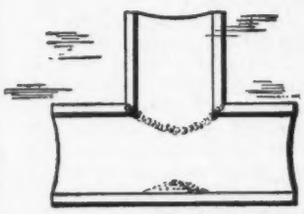
VIBRATION EFFECTS

You need never worry about vibration or strain loosening a *welded* joint.



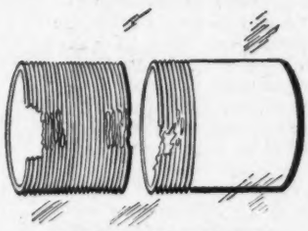
GASKET CHANGES

Fewer flanged joints mean less gaskets—save materials and time.



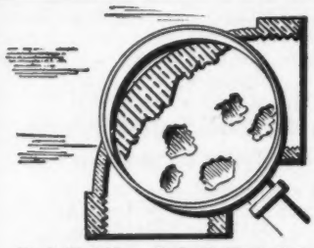
SLAG ACCUMULATION

Butt welds with Tube-Turn fittings virtually eliminate danger of slag.



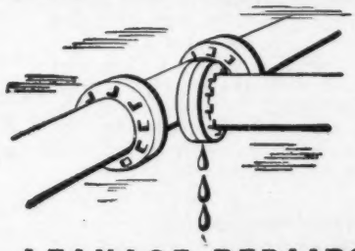
WORN THREADS

Threading thins and weakens metal—causes failures.



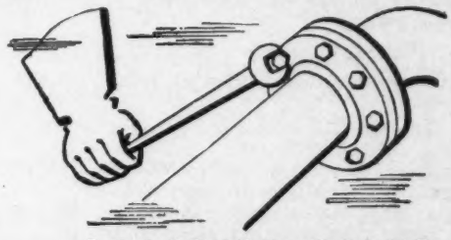
RAPID CORROSION

Tube-Turn fittings resist corrosion because of better metal structure.



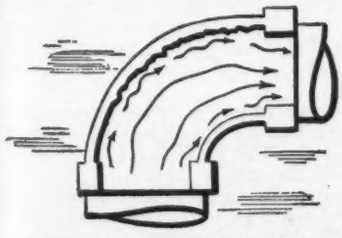
LEAKAGE REPAIRS

No chance of loose connections or leaks with Tube-Turn fittings.



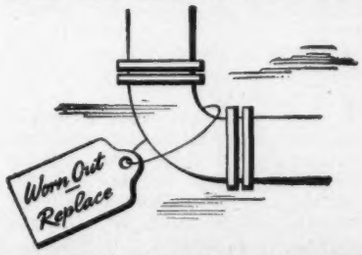
LOOSENED BOLTS

The more welding fittings used, the fewer bolts there are to tighten.



INEFFICIENT FLOW

Easy sweeping radius and no offsets inside mean less pressure loss.



FITTING REPLACEMENT

There's far less time loss or replacement expense with Tube-Turn welding fittings.

SLOW INSTALLATION

Tube-Turn fittings line up perfectly; allow fast, simple, easy butt welding.

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and charging binary mixtures into the viscosimeter. The viscosity data on the methane-propane mixtures have been plotted as a function of molecular weight with lines of constant pressure, charts of constant temperatures in figures included. The charts are extrapolated at temperatures below 77° F. and at pressures above 5000 pounds per square inch.

At atmospheric pressure the viscosity of gases increases with increased temperature, contrary to change of viscosity of liquids with temperature. Viscosities of the normal paraffin hydrocarbons at atmospheric pressure have been determined by several investigators and are plotted as a function of molecular weight, with extrapolation to 896° F. and to 220 molecular weight in one of the figures presented.

Since viscosity of light-paraffin-hydrocarbon mixtures is a function of molecular weight at atmospheric pressure, it might be expected that a similar relationship would hold for higher pressures. To test applicability of two figures given for predicting viscosities under pressure for light hydrocarbon mixtures such as natural gases from the molecular weights or gravities of the gases, a comparison is made between the predicted viscosities and the experimental values reported for natural gases in a table, and predicted viscosities agree with reported values with average deviation of 5.8 percent.

Gas Supply in the Appalachian Area for 1943

By H. J. Wagner, *Chief, Gas Section, Public Service Commission of West Virginia.*

War is calling for more gas to meet expanding industrial needs. No shortage of natural gas exists, but there are shortages of materials for drilling wells and expanding transmission facilities. Natural gas is a big business, sales value of 2800 billion cubic feet marketed in the United States in 1941 having been $608,000,000, with value at wells 4.9 cents per thousand feet and at consumption points 22.1 cents. The Appalachian area marketed more than Texas and Louisiana before 1922, and the industrial East is world's greatest concentrated market, while production practices are more advanced in East than other areas.

West Virginia, fifth gas-producing state, with output comparable with that of the rest of the Eastern states combined, produced only from shallow sands prior to discovery of Oriskany gas field near Charleston, and new fields become increasingly difficult to find. Outlook for 1943 is unfavorable, as present known fields cannot supply sustained or increased demand. Limits of Kanawha-Jackson County Oriskany field are defined except on the west side, and the field probably can supply only about 90 billion cubic feet in 1943, or 25 billion less than in 1942, an amount which will represent a minimum shortage for the state if shallow fields repeat 1941 production of 125 billion. Other Appalachian states have had no material change in production in recent years and cannot be expected to relieve the threatened shortage. Burden of alleviating the shortage falls therefore on West Virginia and areas outside the East.

Remedial steps include drilling wells in proved areas and wildcat areas, despite steel shortage, by taking pipe from old stripper wells.

Only one pipe line connection could be made from Texas fields to the East with existing facilities, a line from West Texas extending to Indiana, where it is tied in with lines leading East. Various lines from the Southwest to the East have been proposed but are not likely to be built while the war lasts. Some relief can be afforded by producing wells through the summer and storing the gas. One storage method is to liquefy gas by compression, but necessary plants require much strategic material. A second storage method is in partially or wholly depleted gas fields. In the past several years, numerous such storage pools have been established. But storage probably will be inadequate to meet the heavy demands of the 1943-1944 season, unless there is at least 100 billion cubic feet in storage in the Appalachian area by the end of this summer.

The existing pipe line from Texas theoretically could deliver about 100,000,000 cubic feet of gas per day into Appalachian area during the summer, but delivery, transmission, and storage arrangements probably could not provide actual accumulation above 75 percent of theoretical. That would make up for the indicated 25 billion-foot decline in Oriskany production for 1943 only to the extent of 14 billion feet. The 11-billion-foot shortage could be made up only by extraordinary production from ordinary wells of West Virginia. With more storage available, the average West Virginia gas well might maintain production of 45,000 cubic feet per day or 16 million per year, in which case the production of 11 billion feet of extra gas in 1943 would require drilling about 700 wells. Beyond these measures, the only way of relieving the Eastern gas shortage would be building of pipe lines to outside sources.

The Economic Position of Natural Gas

By Veleair C. Smith, *Consulting Engineer*

Natural gas is the cheapest of all fuels, besides being highly convenient for industrial and domestic use. Natural-gas reserves have been consistently increased in recent years, but unfortunately, the reserves found generally have not been near markets.

In the East, steel and other strategic industries are geared to natural gas, but gas supplies are not ample for meeting the greatly increased demand. There is threatened, consequently, a slowing down of war production; for if there are not fuels in abundance, it will not be possible to make the steels and other critical products in capacity quantities. Any bottleneck in fuels will cause bottlenecks throughout industry.

Nevertheless, rationing of gas would be inadvisable. It would mean hardships and cause slowing down of the war effort. Meanwhile, the natural-gas industry is being asked to draw on reserves heavily, to the detriment and damage of the reserves and the companies' capital investment, particularly considering that rates of return on investment are restricted. Furthermore, large operators are being forced to devote too much time to non-productive effort in the form of attention to governmental regulations, whereas time could be devoted toward solving the industry's difficult wartime problems.

Standard Oil Company Forms Chemical Subsidiary

Oronite Chemical Company, a subsidiary of Standard Oil Company of California, was formed March 1. Its functions will be the manufacture and sale of chemical products from petroleum. Research and manufacturing facilities will be on the West Coast with sales representatives throughout the country. The immediate objective will be the manufacture of a wide variety of industrial chemicals, now of particular use in the war effort.

H. D. Collier, president of Standard Oil Company of California, is chairman of the board of the subsidiary. T. G. Smith is president. Vice presidents are R. G. Fullis and W. L. Baker. B. W. Letcher is secretary and H. C. Judd is treasurer. K. N. Kundall has been appointed sales manager.

In explaining the background and prospects of the company Collier said:

"The chemistry of World War II is largely based on the by-products of petroleum as the chemistry of World War I was based on the by-products of coal. The list of products that can be made from petroleum is almost unbelievable. It includes plastics, synthetic silks, alcohol, ammonia, formaldehyde and many other things of value to modern industry and modern living.

"Through laboratory and manufacturing facilities of Standard Oil Company of California we expect to produce for the government and for the chemical trade on the Pacific Coast many chemicals which we trust may have great value alike to the overall war effort and to domestic industry."

PAW Asks $685,000 More For Operating Expenses

Expansion of the petroleum coordinator's office into the Petroleum Administration for War will increase the cost of operating the government's oil-control agency during the current fiscal year by $685,000, it was disclosed February 24 when an appropriation of that amount was recommended to the House by its appropriations committee.

The additional sum to be provided represents a little more than 20 percent of the $3,365,000 originally provided for the current year, which ends next June 30.

Testimony taken by a subcommittee during consideration of the bill showed that the increased responsibilities of PAW will require a total staff of 1641 persons by the end of the fiscal year, compared with an estimated average of 990 originally anticipated for the coordinator's office.

About half of the additional money will be required to carry on the work imposed on PAW by the African campaign, it was disclosed by Assistant Deputy Administrator Robert E. Allen. The remainder is necessary for the additional responsibilities imposed on the agency by the President's order of December 2, an outline of which by J. Howard Marshall, chief counsel, drew from Chairman Cannon the comment that "in other words, you have set up a complete dictatorship, with complete and supreme authority in one head, in oil and petroleum products, just as you have in rubber."

"That is correct," Marshall replied, "although we endeavor to dictate as little as possible."

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400 to 1,000 horsepower

Pressures up to 6,000 p.s.i.

Wherever gases must be handled, compressed or processed.

If your equipment must stay on stream for prolonged periods, then you'll want C-B compressors.

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More and more, men in the oil refining, natural gas and process industries who know compressors are buying Type G-MV. This "last word" in compressors, with a compact V-angle engine, is ruggedly built, efficient in performance, economical to operate. It incorporates the sound principles learned in a century of engine building, with modern design features needed to meet the industry's compressor problems of today — and tomorrow, too.

Helping in the production of fuels and lubricants for Allied Victory are these four Type G-MV-4, V-angle compressors in Shell Petroleum's new Cromwell, Texas, plant.

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Rubber Plant Capacity Now 78 Percent Of Baruch Recommendation

FINAL effect of the controversy between military and civilian authorities over equipment for synthetic-rubber plants has resulted in a reduction of anticipated annual capacity of 22 percent instead of a reduction of more than 50 percent as indicated when the several agencies took their problem before James M. Byrnes for settlement last month.

Status of the plant-building program as now constituted has been clarified by William M. Jeffers, rubber director, in his report to Congress February 18. What has happened is that directives have been issued by which stress will be placed on completing plants capable of providing 43.6 percent of the total amount of synthetic rubber recommended by the Baruch committee. These directives, however, do not cancel an additional 34.5 percent of the Baruch total. The latter will progress without benefit of directives and high priorities.

Base figures of the rubber dictator were those compiled by the experts who compiled the Baruch report. In addition to capacity of 877,000 tons of synthetic rubber, this committee recommended addition of 140,000 tons of Buna S and 20,000 tons of Butyl rubber, bringing the full recommendation to 1,037,000 long tons. This figure is 100 percent in all present calculations of the rubber dictator. The additional Buna S rubber was to come from conversion of existing refining equipment.

The second report of the rubber director gives this progress from this point:

"In the fall of 1942, contracts were let for the additional neoprene and the refinery conversions recommended by the Baruch committee.

"For the latter the Houdry process which by then had been sufficiently piloted, appeared to be a most promising method. Consequently, 60,000 tons of annual capacity were allocated to it in addition to the 15,000-ton plant in the initial program and another 15,000-ton plant under consideration for the Pacific Coast. The latter is needed to protect the feed stock situation on the West Coast where the demands of other programs, according to the Petroleum Administrator for War, may force a change early next year from the cracking of naphtha to the synthesizing of butadiene from butane.

"This was the situation November 30, 1942, when progress report No. 1 was issued. Since that time there has been the following new developments:

"1. The shortage of critical components (such as valves, heat exchangers, turbines, blowers, pumps, motors, etc.) is so great that the refinery conversions for 'quick' butadiene production can not be finished in anything like the time originally envisioned by the Baruch committee.

"2. It has been decided that other programs are of equal urgency with the rubber programs, so that further delays must be expected in completing the last part of the rubber program.

"3. The expansion of the high-octane-gasoline program makes it essential that everything possible be done to avoid unnecessary drains upon components, facilities, feed stocks and labor suitable for both programs.

"4. It has become evident that some of the large butadiene manufacturing units may ultimately run at more than their originally rated capacity. It is possible that by the end of 1943 the alcohol butadiene plants may produce 55,000 to 110,000 tons more butadiene a year than their rated capacity.

"Consequently it has seemed suitable to cancel some of the more recently approved conversions which could not be expected to contribute much, if any, 'quick' butadiene needed during the summer and early fall of 1943.

"Though no doubts now exist as to the workability of the Houdry process, transportation facilities incident to the location of certain partly built plants and the difficulty of procuring certain units made it necessary to cancel the contemplated conversions at Wood River, Illinois, Beaumont, Texas, and some others.

"Even though experience should prove the canceling of these conversions to have been an unwise move, the demand for component parts should be so much less by early fall that other steps could then be taken which would not delay their share of the program for more than a month or two, and would still provide the butadiene needed in 1944.

"The accompanying table shows the effect of these developments on the butadiene part of the program.

(United States Only)

Basic Process	Rated Capacities In Terms of Butadiene (short tons)
Alcohol	220,000
Butane	75,000
Butene by dehydrogenation	265,100
Naphtha cracking (refinery conversion)	96,760
	656,860

"The rated capacity of the plants now contemplated will produce enough butadiene to make 761,900 long tons of Buna S. Though the Baruch committee recommended providing enough butadiene for 845,000 tons of Buna S a year, it is not now planned to authorize any further plants except those to produce the recommended 30,000 tons a year from grain. In view of the present shortage of critical components, the possibility that many of the plants will run at better than rated capacity makes it unwise to start new plants until some experience has been gained from those nearing completion.

"Reductions have also been made in neoprene and Butyl programs. Neoprene has been reduced from the recommended 60,000 long tons to 40,000, and Butyl from 132,000 long tons to 68,000. The reasons for these reductions are:

"1. There may be a sufficient excess of butadiene by the winter of 1944 to permit replacement of these tonnages with Buna S.

"2. Further testing and experience have indicated to the military authorities that, except as a last recourse, neoprene and Butyl will not be used for military tires.

"3. The need for isobutylene in the high-octane program is more urgent than its use in Butyl rubber.

"The Baruch committee also recommended additional plants for styrene and copolymerization. None has been started. It is believed that there may be enough over-capacity in the present plants to balance against existing program without further complicating the parts situation. Because of the scarcity of components, new plants, in any case, could not be completed before the fall of 1943. Here again it seems best to use the experience to be gained from plants now nearing completion before starting new plants.

"Therefore, the present rubber program in terms of rated capacities is shown in the following table:

	(1)	(2)	(3)
Buna S	845,000	705,000	83
Neoprene	60,000	40,000	67
Butyl	132,000	68,000	52
Totals	1,037,000	813,000	78

(1) Baruch Committee Recommendations;
(2) Now Building (Rated Capacity);
(3) Percent of Committee Recommendations Now Building.

"Plants are now being built to make enough butadiene to produce 761,900 tons of Buna S and enough styrene to produce 798,000 tons of Buna S."

After referring to his first report, which indicated possible delays and citing the plan to use the directive in scheduling construction, the report continued:

"On December 4, 1942, part of the program was given urgency numbers and directives, with an understanding that, in order to complete the necessary plants, a further increment would be given the same treatment a month later.

"On January 29, 1943, a further determination was made of this matter.

"As of today, plants now sequenced and under directive, together with those finished or expected to be finished during the next few months, have total rated capacities of 452,000 tons of synthetic rubbers a year, or 43.6 percent of the 1,037,000 tons recommended by the Baruch committee."

Plant capacity being provided under these directives is shown in the following table, which shows percentage relationship to recommendations of the Baruch committee:

	(1)	(2)	(3)	(4)
Buna S	845,000	435,000	51.5	41.9
Butyl	132,000	7,000	5.3	.7
Neoprene	60,000	10,000	16.6	1.0
	1,037,000	452,000	43.6	43.6

(1) Baruch Report Recommendation;
(2) Now Under Directives;
(3) Percentage of Capacity Recommended by Baruch Committee Now Under Directives;
(4) Percentage of Total Committee Program.

Five Butadiene Plants Suspend Construction

Construction has been postponed on five butadiene units within the refining industry as a result of the decision to complete sufficient capacity for 43.6 percent of the capacity originally planned for synthetic rubber. This decision came last month after extended controversy between Washington agencies over allocation of materials.

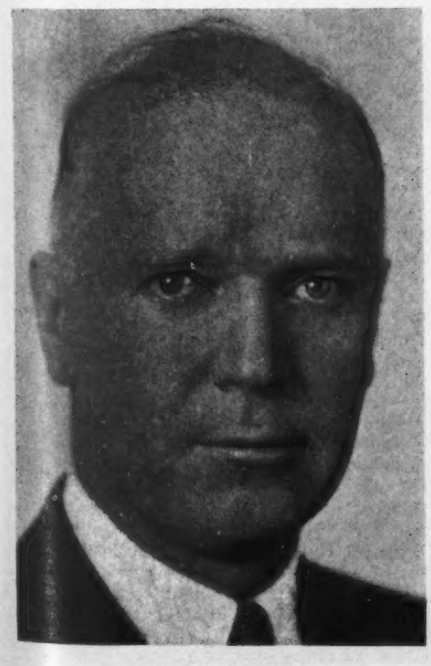
The projects postponed are in what the industry styles "conversion jobs," whereby existing refining capacity would be adapted to making butadiene by the addition of special equipment. Largest of the five was the unit of Standard Oil Company (Indiana) at Wood River, scheduled to provide 40,000 tons of butadiene per year. Since the 3500-ton unit of Ohio Oil Company at Robinson, Illinois, would have used purification facilities at Wood River this one also was taken from the list.

At Texas City the unit of Pan American Refining Corporation has been removed. This unit did not include purification facilities, since a unit for this purpose is under construction at another nearby plant. Magnolia Petroleum Company, Beaumont, has halted work on a 15,000-ton plant, whose raw output would have been purified at another adjacent plant. The fifth plant suspended is the Mohawk Petroleum Company, Bakersfield, California, whose capacity was rated at 10,000 tons.

Egloff Before Sections Of Chemical Society

During February Dr. Gustaf Egloff, research director of Universal Oil Products Company, Chicago, spoke before sections of the American Chemical Society in southern cities on the subject, "Substitute Fuels in a World at War."

His itinerary included Kingsport, Tennessee, February 15; Knoxville, February 16; Chattanooga, February 17; Chattanooga, February 18; Sheffield, Alabama, February 19, and Birmingham, February 20.



WES W. DUNLAP

THE LOOK BOX

California Refiners Elect New Officials

C. A. Johnson, Social Oil & Refining Company, Los Angeles, was elected president of the Independent Refiners Association of California at the annual meeting February 5. It was the seventh annual meeting of the association.

Other officials are Henri Brown, Operators Oil & Refining Company, Long Beach, and M. M. McCallen, McCallen Refining, Long Beach, vice presidents; A. M. Lockhart, Envoy Petroleum Company, Long Beach, secretary and treasurer.

Dr. Boord Will Lecture to Southeast Texas Chemists

Dr. Cecil E. Boord, Ohio State University, supervisor of the API pure hydrocarbon research program since 1938, will address the Southeast Texas section of the American Chemical Society, on March 17 and 18. His subject will be: "The Synthesis of Pure Hydrocarbons and the Relation of Their Physical Constants of Molecular Structure."

The March 17 lecture will be in Port Arthur and the next evening the lecture will be given in Houston, at 8:00 p.m., in the Warwick Hotel.

Promotions Made by Pennsylvania Group

Samuel F. Pratt, assistant manager of the Pennsylvania Grade Crude Oil Association for the last three years, was elected to the post of general secretary of the organization by the directors at a meeting held in Oil City January 29. The action of the board thus fills the post which has been vacant since the death of J. E. Moorhead last August.

At the same meeting the board elected Wes W. Dunlap, publicity director, to the position of assistant secretary.

Pratt, who entered the service of the association 10 years ago, as a field division representative in St. Louis, was born in Titusville and attended school in Oil City. Following his assignment in St. Louis he went to Philadelphia as the field representative for that area. He came to Oil City as supervisor of the field staff in 1935 and went to Europe as manager of the overseas division the following year. He returned to Oil City just before the outbreak of the war in 1939.

Dunlap, who succeeded Moorhead as publicity director in 1934, is a former newspaperman. He came to Oil City from the publicity department of Pennsylvania State College.

Staff at Institute of Gas Technology Enlarged

With the increased demands of war research calling for additional personnel, the Institute of Gas Technology, Chicago, has added four men to its staff. They were appointed to the fundamental and applied research staff. All have assumed the duties of research associates. The new appointments give the Institute a staff of 27 members.

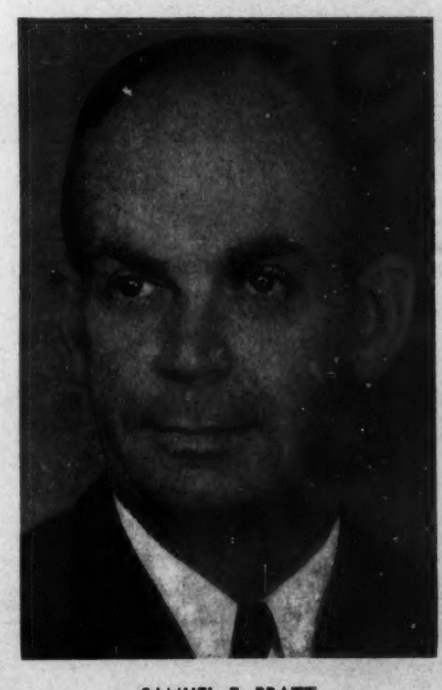
The four new staff members are Dr. Samuel William Martin, George Jay Verbeck, Cornel Wohlberg and Vito Charles Lazzaro.

Dr. Martin comes to the institute from the National Lead Company, Titanium Division, where he was a research physical chemist. For a time he taught physical chemistry at Yale University where he received his Doctor of Philosophy degree. He received his Bachelor of Arts degree from Williams College and did post doctorate work at Princeton University.

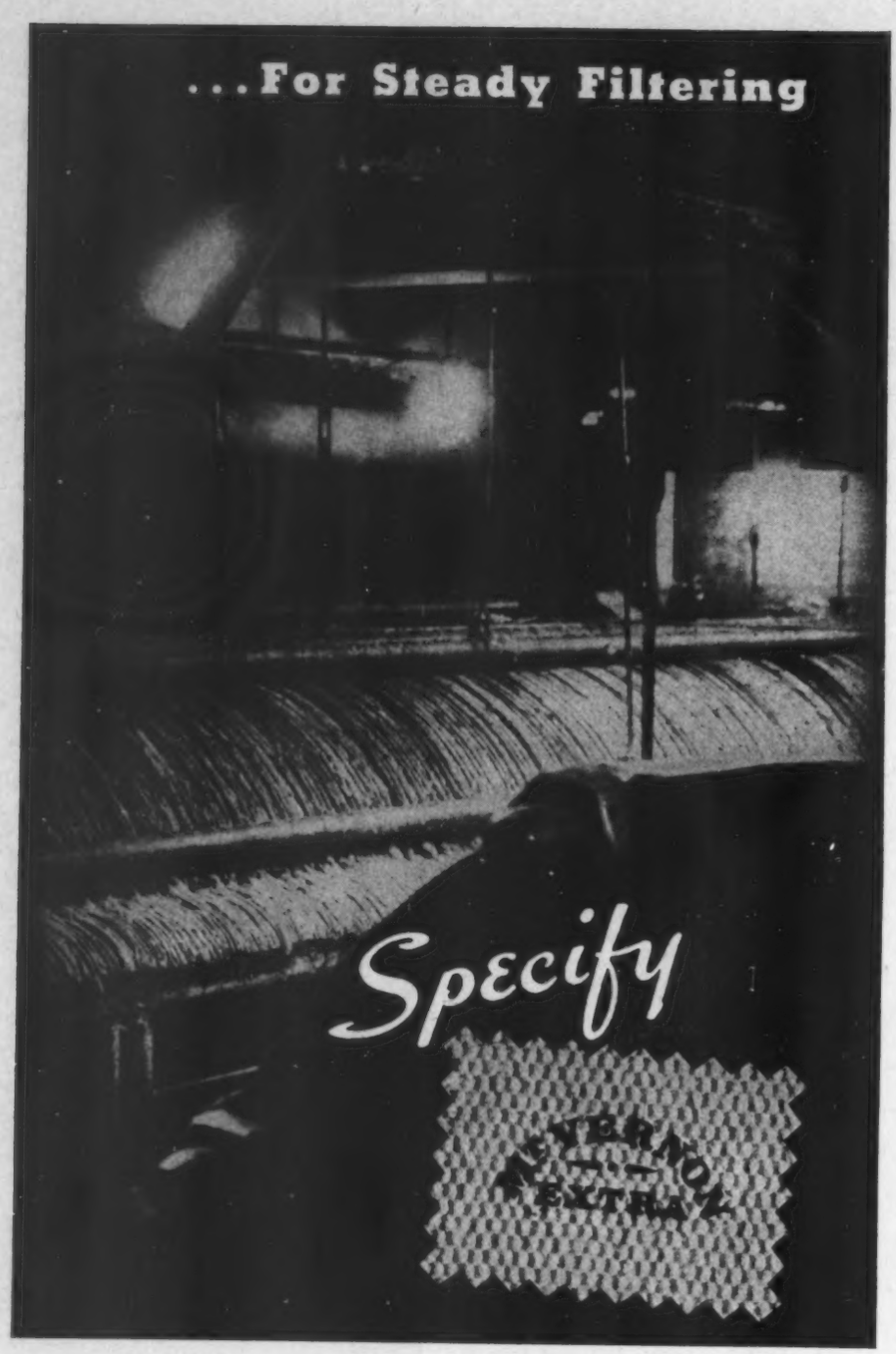
Verbeck, formerly was a research chemist with Abbott Laboratories and the Portland Cement Association. His undergraduate work was done at Lawrence College, and he received his Master of Science degree from the University of Chicago. He was a laboratory assistant at Lawrence for two years.

Wohlberg did analytical and laboratory work at the National Lead Company, Titanium Division, from 1930 to 1935. For the next three years he did research work for that company. Also for a time he was research chemist acting in charge of the laboratory at the International Tailoring Company, Division of Reiss Manufacturing Corporation. Wohlberg is a graduate of Polytechnic Institute of Brooklyn with a Bachelor of Science degree.

Lazzaro, prior to coming to the institute, did research work for the West Virginia Pulp & Paper Company for five years. He also formerly served as laboratory instructor in qualitative analysis and inorganic chemistry at Tufts



SAMUEL F. PRATT



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College where he received his Bachelor of Science degree.

The Gas Institute, established in 1941, is affiliated with Illinois Institute of Technology, and is devoting a large portion of its time to projects of military importance.

In its first year of existence, war came to America, and the Gas Institute became necessarily war-minded since it represents a fuel-producing industry.

The objectives of the Gas Institute, as listed at its inception, are as follows:

1. To provide specially trained manpower for the immense industries that deal with natural or manufactured gases.
2. To serve as a center of fundamental and applied research on problems pertinent to production, storage, distribution, measurement and utilization of gas, and its by-products.
3. To stimulate, correlate, encourage and supplement research that is of benefit to the gas industries.
4. To collect and disseminate scientific information applicable to betterment of the industry.

In order to gain full advantage of scientific manpower the institute has adopted a two-point program, which will go into effect immediately. The program concerns new selectees for fellowships.

These technical students are scheduled to begin their regular training program in June, but because so many colleges are operating under wartime accelerated programs, graduation dates of the new fellows vary considerably.

So provision is being made under the new program to make maximum use of these extra man hours. The new fellows will be assigned to war research projects as rapidly as they complete their college training and will work at this activity until their regular training program starts.

Then, in the second stage of the program, these men will commence their specialized training by being assigned to actual practice in the gas industry.

Future Prices Will Be Determined by Agreement

Charges to be made by oil companies for services in storing and distributing aviation gasoline for the Army and Navy after February 16 are to be determined through agreement between the oil companies and the War and Navy Departments, under an amendment to the general maximum price regulation issued February 10 by OPA.

Adoption of the amendment follows a change in the method by which the military services acquire their aviation-gasoline supplies. Formerly the departments bought on the basis of specified delivered prices, but now the refineries sell the gasoline at refinery points to the Defense Supplies Corporation, which in turn sells it to the Army and Navy, which arrange with the companies for its delivery at various times and places.

Under this system, the companies order shipments from refineries to terminals or bulk plants, handle and store the gasoline, re-route cars, and provide transportation from refinery terminals and bulk plants to destination.

Since these services were not performed in March, 1942, the base period for GMPR, it was necessary to provide a method for compensation of the companies. The prices agreed upon between the companies and the departments are to be filed with OPA for approval.

The fabrication of high-temperature, high-pressure process equipment is no sideline at B&W. Here, new problems encountered by producers of butadiene, toluol, and other "Ingredients of Victory" are constantly being solved.

In the course of this development, B&W engineers have created new manufacturing techniques that save steel and save time, without sacrificing safety. Let The Babcock & Wilcox Co. apply this new knowledge to your process equipment requirements.

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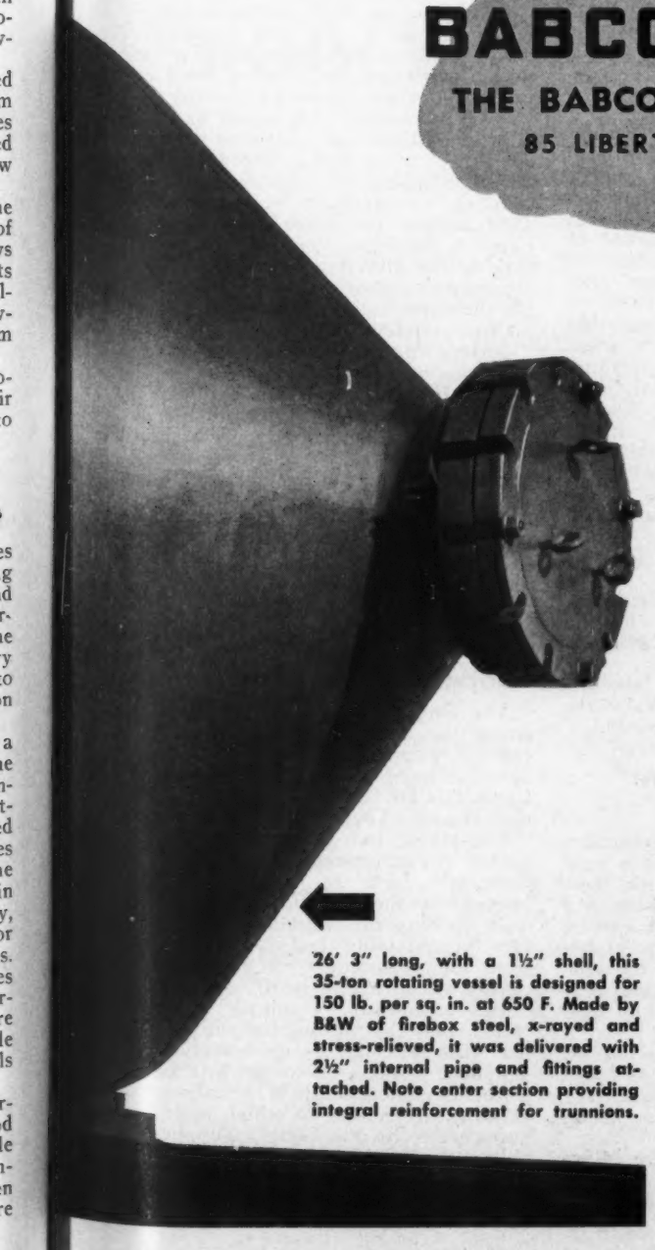

26' 3" long, with a 1½" shell, this 35-ton rotating vessel is designed for 150 lb. per sq. in. at 650 F. Made by B&W of firebox steel, x-rayed and stress-relieved, it was delivered with 2½" internal pipe and fittings attached. Note center section providing integral reinforcement for trunnions.

These B&W Tube Support Castings for an oil heater furnace are part of an eleven-thousand-pound order, all of 25% chrome, 12% nickel alloy. More than two million pounds of tube support castings have been furnished by B&W for service at temperatures as high as 2000 F. No service failures have been reported. B&W also furnished all related links, bolts, nuts, etc.

This 17"-diameter Streamlined Opening, made by the B&W Pushout Method from 6¼" plate, is welded into a 66"-diameter shell, designed for a working pressure of 1475 lb. per sq. in. B&W Streamlined Openings reduce stress concentrations, permit lighter weight with safety.

S-34-T

Federal Agencies Lack Coordination

Lack of coordination among the federal agencies interested in oil, and deficiencies in the administration of rationing continue to interfere with the solving of the problem of supply, the Senate was told February 22 in a report by its special oil committee headed by Senator Francis Maloney of Connecticut.

Summarizing the results of a series of hearings held during January, the committee foresaw little improvement in the over-all picture, not only this year but during coming wartime winters, and admitted it was unable to offer any comprehensive program beyond emphasizing that the steps taken and contemplated by PAW and other agencies should be pressed.

Still further authority, substituting the "vital power to make final decisions and to enforce them in the various agencies" for the persuasion to which he now is limited, was urged for the petroleum administrator, with WPB to reconcile differences which may arise between the oil program and some other program as a result of PAW directives.

Also badly needed, it was declared, is better planning and cooperation on the part of the military authorities, lack of which caused a severe crisis last December when the military found it necessary to demand large quantities of oil for use in north Africa.

"At the present time arrangements are being worked out whereby Army and Navy officers will work closely with the petroleum industry and the PAW," the report explained. "Active cooperation between these authorities is essential, with the military making every effort to advise civilian authorities of its needs reasonably far in advance. Actual military needs for battle operations must come first; but, on the other hand, complete disruption of civilian transportation, or recurring periods in which households are unheated, would produce a situation at home which would impair the war effort as seriously as a military defeat."

Much of the hardship suffered by fuel-oil consumers, the committee held, results from a price structure "which discouraged the production, transportation and accumulation of fuel oil in the places where it was most seriously needed," but its previous recommendation for improvement of the price situation was not directly renewed.

Recommendations

Among the necessities of the situation, as seen by the committee are:

A proper balance between the quantities of fuel oil and gasoline production;

The pooling of oil for transportation, discontinuing the present practice of specifically earmarked individual shipments by companies to specific consumers;

Greater use of tankers to supply the East Coast;

Increased use of barges;

Greater ingenuity to utilize makeshifts, such as the use of box cars for the movement of oil in drums.

Better utilization of existing tank trucks.

Investigation of possible methods of transportation which might consume less steel than pipe lines.

The committee was outspoken in its criticism of rationing methods, declaring that fuel-oil rationing should be simplified and much wider discretion given local ration boards and kerosine and range oil should not be rationed at all.

Pointing out that little can be done to ease the situation this winter, the report recommended that for the next heating season serious consideration should be given to a straight-line percentage cut based on use during the 1941-42 season with provision for local boards to grant relief in hardship cases.

Kerosine and range oil, used primarily by poor persons "who are not addicted to waste and who have not the funds to insulate their homes," should not be rationed, it being maintained that much hardship was caused this season by the bogging down of rationing.

With respect to gasoline rationing, however, the committee held the system should be tightened on the East Coast, to eliminate black markets, but nationwide gasoline rationing for the purpose of conserving rubber should be put on the basis of mileage with due weight given to the availability of rubber to the particular driver and his individual needs.

Restrictions on the use of gasoline by trucks should be made as light as possible in the case of farmers, but the committee felt that some types of trucking operations might be eliminated to save tires.

Supply Association Considers Manual

A fourth printing of the Technical Manual of the Natural Gasoline Supply Men's Association is under consideration. At the request of its board of directors members are being asked to express opinions as to the advisability of issuing this manual, whose data concerns the natural-gasoline industry.

This matter came out of the meeting of directors February 19 at Tulsa, when consideration was given to the coming annual convention of the Natural Gasoline Association of America, Dallas, April 14, 15 and 16. The report on this was "that the scale of the entertainment might be somewhat reduced due to war restrictions but otherwise it was agreed a duplication of the highly successful stag evening presented in 1941 at the Baker hotel should be planned for this year."

G. B. Bailey, Vinson Supply Company, Dallas, was named chairman of the entertainment committee. He will select members of his committee.

The report of the treasury showed "a healthy condition." The Walworth Company was added to membership.

UOP Announces Dixane Catalytic Process

Universal Oil Products Company, Chicago, announced the use of a new catalytic process, Dixane, which consists of "grafting two carbon atoms into the structure of certain hydrocarbon compounds." Details are not printable because of military secrecy but the process is classed as assuring increased quantities of 100-octane aviation gasoline.

The molecule accomplished is classed as having a character all its own "because the atoms comprising it are hooked together in a peculiar way which hitherto was unattainable.

"The new molecular structure is accomplished by the use of a catalyst which has been discovered in UOP laboratories."

Refining Equipment Gets Higher Rating

Manufacturers of refining equipment were among those given an AA-1 preference rating as Class A activities in regulation issued in February by War Production Board for administraiton of its Controlled Materials Plan.

CMP, eventually to control the distribution of all scarce materials, governs the use of steel, copper and aluminum by the various industries to complete authorized production schedules for which allotments of any of the metals are made to a prime contractor manufacturing Class A products.

The regulations define the place of preference ratings under CMP and provide methods for obtaining maintenance, repair and operating supplies. Previously issued regulations cover applications for, receiving and passing on allotments; inventory limitations, and sale of controlled materials by warehouses and distributors, and a final set of rules shortly to be issued will cover construction and remodeling of facilities.

Where manufacturers have been given allotment numbers or symbols for a specific program, their preference rating will move up a step, and a rating of AA-1 with an allotment number will take precedence over another AA-1 rating without an allotment number, but will be secondary to a rating of AAA, with or without an allotment number. An AAA rating takes precedence over all other orders.

When an allotment is passed on to a secondary consumer manufacturing Class A products, the prime consumer making the allotment will apply to the secondary's authorized production schedule the same rating he has received for his own related schedule.

Orders for maintenance, repair and operating supplies will carry the symbol MRO after the preference rating.

The preference ratings assigned by the regulations supersede those assigned by orders in the "P" series for maintenance, repair and operating supplies, in the case of materials or products to be delivered after March 31. All "P" orders, however, are specifically continued in existence and all restrictions and requirements contained in them remain in full force.

Consumers, Suppliers Must Cooperate for Chemicals

The importance of cooperation between the consumers and suppliers of critical chemicals is stressed in an announcement recently released by the Chemicals Division of the War Production Board. The statement follows:

"Suppliers and distributors of products manufactured from allocated chemicals have on many occasions brought to the attention of the chemicals division the difficulty which they face in obtaining end-use information from their customers. It is the policy of the chemicals division to distribute critical chemicals by specific allocation rather than by preference ratings and for this reason it is essential for suppliers of these chemicals to transmit to the division accurate information concerning the end-use to which their products are to be put. Clearly, suppliers of allocated chemicals can obtain this information only from their customers, who in turn must usually obtain similar information from their own customers.

VERSION

Another PHILLIPS contribution toward greater production of needed war materials

More and better aviation gasoline...greater quantities of essential ingredients for synthetic rubber and for explosives . . . all result from CYCLOVERSION — a new development in catalytic cracking which Phillips Petroleum Company has put into use at one of its refineries.

While it is feasible, by means of CYCLOVERSION to build aviation gasoline which greatly exceeds existing standards for 100-octane fuel, the important, immediate application for the process is to increase production of present type "fighting-grade" fuel.

The Petroleum Administration for War has recently approved a Phillips' project for the construction of a new, large CYCLOVERSION unit. Phillips now offers this new process to other companies who may desire to employ it in government approved projects for the manufacture of products required in the Nation's aviation gasoline, explosives and synthetic rubber programs.

CYCLOVERSION requires substantially smaller quantities of critical construction materials than many other catalytic processes. A large number of existing catalytic and thermal cracking installations are readily convertible to CYCLOVERSION.

Write or Wire

PERCO DIVISION

COMPANY *Bartlesville, Oklahoma*

A number of chemical orders require applicants, on form PD-600, to obtain certificates from their customers so that they may have accurate information on which to rely. Other orders, which do not have the certification provision, nonetheless require an applicant to discover and certify to the division the uses to which his product is to be put.

"Where an allocated chemical is required to make another product which is also under allocation, it is sufficient in applying for the first product merely to indicate the WPB order number governing the second product as adequate end-use information. The applicants for the second product will be better able to indicate the ultimate use.

"It is realized that in many cases the transmission of end-use information by a customer to his supplier goes against long established commercial custom. Nevertheless, in view of the shortages of many critical chemicals and the necessity in time of war that these chemicals be used solely for the most essential purposes, it is unavoidable that this information be obtained by each supplier from his customer. The only alternative would be for each customer, in each layer of industrial processing of each product, to transmit the information direct to the division, a procedure which would involve an immense amount of paper work for all concerned and would require bureaucratic control beyond all reason.

"In view of the above, it should be clear to all factors in the industry that a supplier of products manufactured from allocated chemicals is required to obtain end-use information from his customers and that his customers should extend to him the utmost cooperation in furnishing this information."

Tide Water Promotes Caine and Chase

Herbert S. Chase has been appointed manager of manufacturing of the eastern division of Tide Water Associated Oil Company. His promotion from superintendent of the refining plant at Bayonne was to fill the post held by the late Charles R. Barton.

Chase, a graduate of Harvard University, has had wide experience in refining and has been with Tide Water Associated Oil Company since 1922.

George S. Caine, who has been assistant general superintendent at Bayonne, has been advanced to superintendent. He has been with the company since 1926 when he joined the staff of the research and development department. Caine is a graduate of Massachusetts Institute of Technology.

Adequate Heat Exchangers Assured by WPB

Adequate supplies of heat exchangers for aviation gasoline, synthetic rubber and other operations using such equipment were assured by WPB February 22, in an announcement that in spite of the large backlog of orders the industry will be able to complete all demands made upon it during 1943.

More than $200,000,000 worth of heat exchangers is to be produced this year by an industry which in pre-war years was of small size and in 1941 had a production of only $65,000,000.

Employes at Richmond Plant Get "E" Award

In recognition of "outstanding production of war material" the Army-Navy "E" award was presented February 19 to 3000 employes of the Richmond refinery of the Standard Oil Company of California. The presentation was made by Vice Admiral John W. Greensdale, U. S. N.; and the "E" flag was accepted on behalf of the refinery by H. D. Collier, president of the company. Colonel Milton O. Boone, U. S. A. presented silver pins to Miss Blanche Lydicksen and Ira E. Bonham, representing the employes, all of whom later will receive similar pins. Bonham has been working in the refinery nearly 20 years.

Two Gasoline Plants Will Be Constructed

Gasoline-plant construction in Oklahoma and in Louisiana was announced in February.

Otha H. Grimes, Tulsa, will build a high-pressure-absorption plant in the Pauls Valley field, Garvin County, Oklahoma. The plant will have capacity for 5,000,000 cubic feet of gas daily. Processing will provide for removal of propane and butane.

Claiborne Gasoline Company has authorized erection of a 50,000,000-foot daily capacity well-pressure absorption type natural-gasoline plant in the Lisbon field, Claiborne Parish, Louisiana. The company has made long-term contract with Big West Drilling Company

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Any gauge glass is weakened if it's scratched. But, *unscratched*, PYREX Gauge Glasses last longer than other glasses. That's partly because they are made far stronger than necessary to withstand ordinary plant pressures, and partly because the glass from which they are made is highly resistant to corrosion. In fact, it is so inert to all acids except hydrofluoric, that it has been widely adopted for piping by the chemical industry.

And whether dimly or brightly lighted, PYREX Broad Red Line Gauge Glasses have the added advantage of being easier to read, from a distance. That's a safety feature, as you know if you've been near a glass when it blew. It's an efficiency feature, too—a step-saver and a time-saver.

Next time you call your jobber, specify PYREX Broad Red Line Gauge Glasses.

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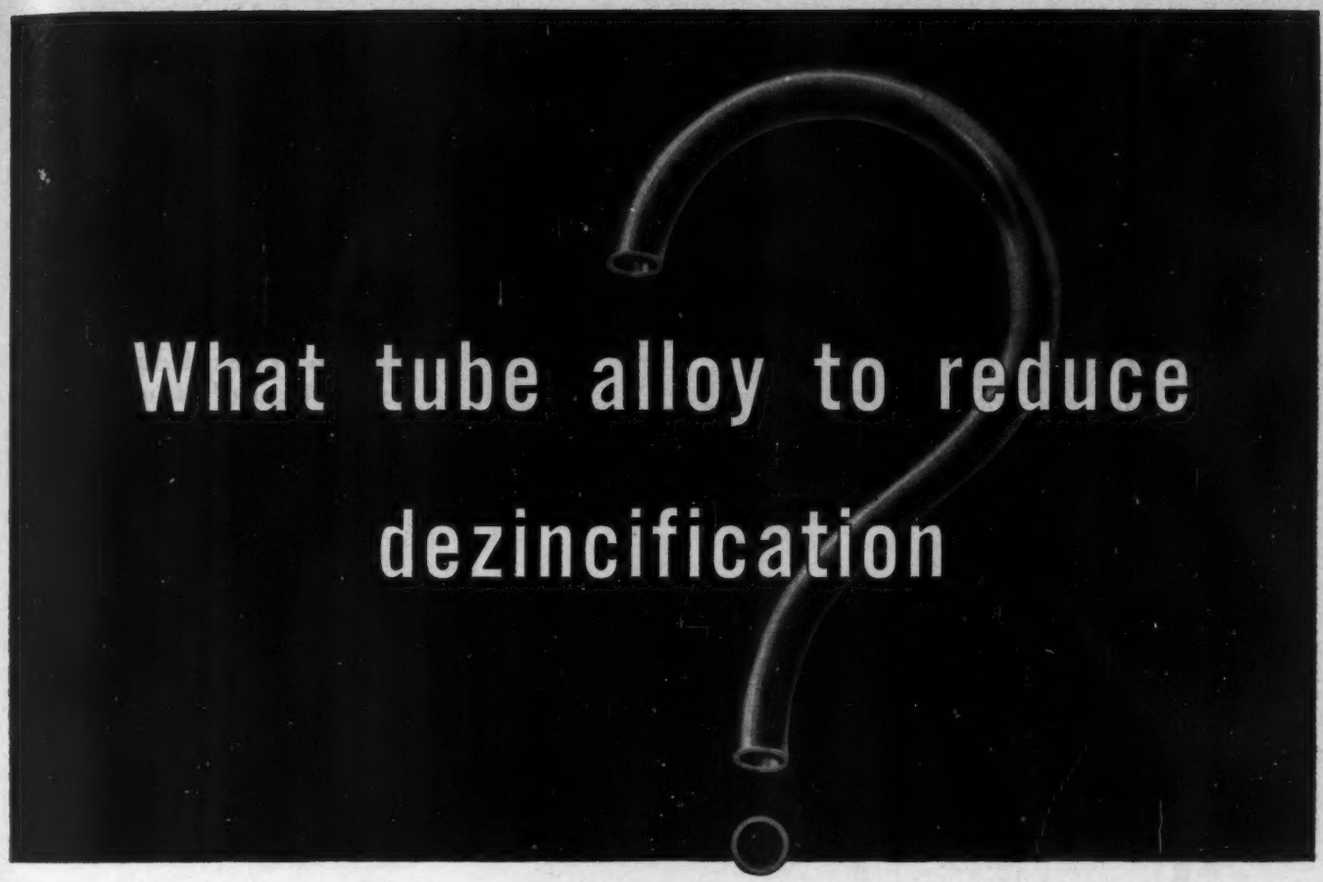

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It is a function of the engineers of our Technical Department to assist Condenser Tube users in the selection of the most economical tube alloy for any given set of operating conditions. Please feel free to call on us. Publication B-2, sixth edition, gives up-to-the-minute data on Anaconda Condenser Tube and Head Plate Alloys. A copy will be mailed to you for the asking

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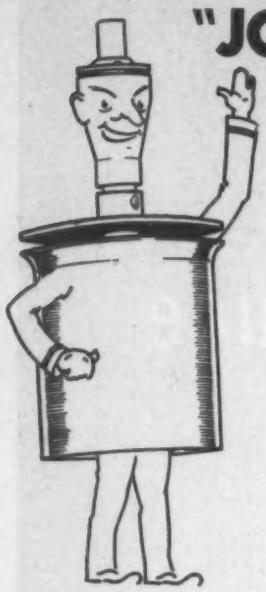

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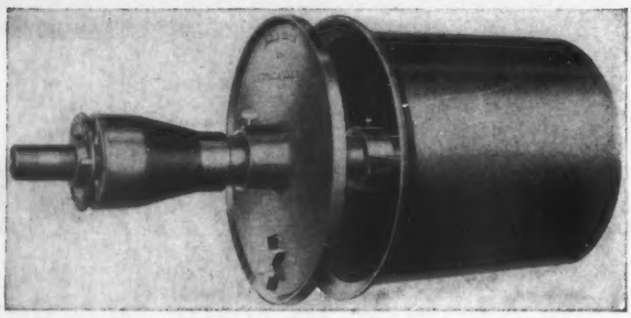

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John Zink Bi-Mix Burners burn gases of varying heat values without adjustment, and they are not damaged by slugs of oil, gasoline or water, that sometime blow through them from the fuel line.

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to deliver a minimum of 35,000,000 feet of gas daily and to drill necessary additional wells to fill gas sales contract. The residue gas from the plant will be sold to Ozark Ordnance Plant, near El Dorado, Arkansas, with deliveries to be made through Arkansas Pipe Line Company's system. Surplus residue gas will be sold to Memphis Natural Gas Company, which will use Arkansas Pipe Line Company's line to its Monroe station.

Claiborne Gasoline Company is owned largely by M. H. Marr, J. H. Pritchard and W. J. Holderman.

Charge "Conspiracy" Halts Grain Alcohol Plants

A suggestion that there may be a "conspiracy" in the chemicals branch of WPB to prevent the building of any more alcohol plants was voiced February 25 by Paul Hadlick, counsel for the Senate agriculture subcommittee investigating the rubber program.

Hadlick expressed his opinion during a hearing at which testimony was introduced that the department of agriculture favored the building of alcohol plants at points throughout the country where surplus stocks of grains were available.

Senator Guy M. Gillette of Iowa, chairman of the subcommittee, expressed agreement that WPB has been "successful" in discovering obstacles to the program and that confusion and differences of opinion exist as to the need for additional plants.

"The committee," he said, "has been advised on one hand that we have ample supplies of alcohol. Other authorities maintain that if the synthetic-rubber program is expanded they don't know where we are going to get the alcohol."

PAW Forms Foreign Oil Committee

Formation of a foreign petroleum committee, composed of representatives of the federal agencies having an interest in foreign oil matters, was announced by PAW February 26. Following a meeting of government representatives February 25, at which the broad objectives of the committee were discussed, Deputy Administrator Davies extended invitations to serve on the committee to: Dr. Herbert Feis, advisor of international economic affairs, State Department; Robert P. Patterson, under Secretary of War; James E. Forrestal, under Secretary of the Navy; Milo Perkins, executive director, Board of Economic Warfare; E. R. Stettinus, Jr., Lend-Lease Administrator; Admiral Emery S. Land, chairman of the War Shipping Administration; and Nelson A. Rockefeller, coordinator of Inter-American Affairs. The principal function of the committee will be to determine how the United States can best direct its petroleum supplying efforts in relationship with probable theaters of war.

One-Day Meeting for Utilities Association

Instead of its annual meeting, the Oklahoma Utilities Association will confine its 1943 deliberation to a conference of one day, March 22, in the Mayo Hotel, Tulsa. This conference will be in the nature of a round-table discussion.

What WE can do:

1 Advise on WPB requirements. Special departments keep fully informed on Government regulations. Help metal users solve priority problems.

2 Help *new* users of Monel, Nickel, Inconel and other special alloys. We offer practical advice on welding, machining, heat treating and other processing methods.

3 Special sizes and shapes in stock. Stocks maintained complete as possible under wartime conditions. By suggesting alternate sizes or materials, we often keep production moving.

4 Special services...such as cutting, shearing or sawing to size...help overloaded plant facilities. Delivery as needed keeps metal moving to machines.

5 Mill orders. A close working knowledge of mill conditions enables us to handle mill orders with maximum efficiency, thus helping to relieve the burden on overtaxed mills. We...where possible...offer part shipment from our own warehouse stock.

● By working closely with the distributor, by asking for advice as well as metal, you can eliminate many delays, cut down useless paper work and step up production of finished war materials.

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Milwaukee—Steel Sales Corporation, 647 W. Virginia St.
Minneapolis—Steel Sales Corporation, 529 S. 7th St.
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New Orleans—Metal Goods Corporation, 413 Canal Bldg.
New York—Whitehead Metal Products Company, Inc. 303 West 10th St.
Philadelphia—Whitehead Metal Products Company, Inc. 721-729 Arch St.
Pittsburgh—Williams and Company, Inc. 901-937 Pennsylvania Ave.
St. Louis—Steel Sales Corporation, 4565 McRee Ave.
San Francisco—Pacific Metals Co., Ltd., 3100 – 19th St.
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Engine and Lubricants Research At Armour Foundation 1941-1942

Developments in engine and lubricants research at the Armour Research Foundation for 1941-42 reveal trends in diesel-engine activity and in additives for lubricating oils. The report which follows is part of a more extensive outline of activities of the foundation as presented in Chemical and Engineering News, January 10, 1943.

"The Engine Research Laboratory is completing its second year of service to the oil industry in research, experimental, and development work on lubricating oils for heavy-duty, internal-combustion engines. The present emergency has greatly increased the need for and the use of such lubricants. American oil companies are supplying huge quantities of heavy-duty compounded oils to the American armed forces on a wide battle front, and also through Lend-Lease to the battle fronts of the United Nations. Approximately 4000 square feet are devoted to this lubricating oil work and the test equipment includes a wide variety of test engines, dynamometers, and related apparatus.

Engine Lubricants

"Since all of the oils meeting the specifications for use in the armed services are chemically compounded oils, the chemical engineering groups in the oil industry and the chemical industry have greatly increased their facilities for the production of these compounding agents. Where their manufacture has required priority materials, the industry has improved production methods to use less of these materials or has changed to the use of less vital materials.

"The chemical laboratory methods for inspection of a lubricating oil have failed to give an accurate evaluation of lubricants for use in engines of the heavy-duty type. These laboratory tests are used in conjunction with small-scale engine tests or full-scale engine tests to give a more accurate prediction of service value. The full-scale engine tests are required on the completed lubricant before acceptance by the armed forces or before their recommended use by many of the engine manufacturers.

"Caterpillar Tractor Company, pioneers in the field of engine testing of diesel engine lubricants, and General Motors Corporation have established test procedures for the guidance of the oil industry. The procurement departments of the armed services have availed themselves of these accepted test methods and have written their specifications around them. The present 2-104A specification requires that the lubricant shall have been tested according to these two standards and shall have been found satisfactory as adjudged by an inspection of the test engines at the completion of the tests. The oils must also meet rigid requirements such as pour point viscosity index, and filter adaptability.

"Engines of both the spark-ignition and compression-ignition types are used in these evaluation tests since both of these types require lubricants of special characteristics in certain cases, and both types are used in the armed services and have a wide commercial application. The Engine Research Laboratory has two types of spark-ignition engines and five types of compression-ignition engines totaling fourteen engines in all. Routine chemical inspections of the new and used oil are made in the usual manner to supplement the information obtained from the engine tests.

"These engine tests and used oil sample analyses give evidence of the suitability of an oil for heavy-duty service by evaluating its oxidation resistance, its detergency and dispersive ability, its neutral action with respect to the commonly used alloy bearings and film strength. The oil is also examined for its ability to perform the following functions:

"1. Maintain a very low wear rate for all rubbing surfaces.

"2. Maintain an unbroken oil film between rubbing surfaces to prevent scratching, scuffing, or spalling.

"3. Act as a coolant to keep rubbing surfaces cool and remove heat from such places as the under side of the pistons.

"4. Act as a seal to minimize blow-by of air and products of combustion into crankcase.

"5. Maintain working parts in reasonably clean condition. This includes keeping the piston rings free in their grooves and the prevention of the formation of excessive carbonaceous varnish or lacquer deposits which interfere with heat transfer and reduce operating clearances.

"6. Maintain engine interior clean so that any sludge formed is removed in the drain oil or by the filter.

"7. Prevent corrosion of copper-lead, cadmium - silver, and cadmium - nickel bearings by the action of oxidation products on the loaded portions.

"8. Provide lubrication at lower operating temperatures and enable easy starting under adverse conditions.

"The research and testing work done at the Engine Research Laboratory include three general types:

"1. Research on oils which are prepared for a special purpose and on which very little test work has been done. This group includes oil using (a) unconventional base stocks in combination with widely used additives or additives which are of an experimental nature, (b) base stocks employing newly developed refining processes in combinations with various additives, (c) base stocks prepared by different blending of the components in combination with additives of various types, (d) base stocks in combination with more than one additive, and (e) conventional base stocks using untried additives.

"2. Development work on oils on which some field experience and limited laboratory inspections are available. These may include any of those shown in the previous group except that these oils have been used in full-scale engines.

"3. Testing of lubricants on which rather extensive laboratory and field experience is available and which require certification entails comprehensive full-scale engine tests after which the test parts are inspected and the oil evaluated accordingly. Used oil analyses supplement the engine operational and condition factors.

Additives

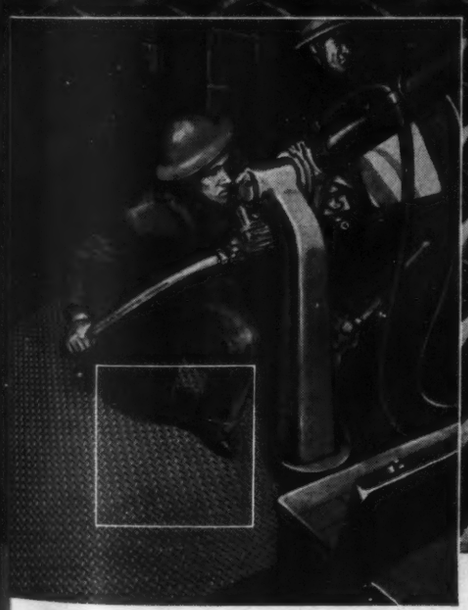
"The above grouping may serve to demonstrate the complicated pattern of lubricant preparation and the great number of variables involved. The development of new refining processes has greatly increased the available oils for heavy-duty service. The more extended use of additives and the development of new additives have also greatly increased the available supply of heavy-duty lubricating oils. The Engine Research Laboratory has played an important part in the development and evaluation of these new oils and additives.

"The trend in additive composition is naturally away from the use of priority or vital materials both as regards the materials in the additive and the materials used to produce the additive. The additives which have been so popular to date usually contain a metallic soap in combination with other materials. Metals which have been widely used for this purpose include tin, zinc, aluminum, magnesium, barium, calcium, cobalt, and lead. Recent additive developments are aimed at the elimination of the metal soap or the metal salt with the retention of its desirable properties and the elimination of most of its faults.

"The metal shortage created by the present emergency has caused a revival of research work on the use of treated animal, vegetable and fish oils as compounding agents. Fats and waxes from agricultural products are also being investigated for suitability as lubricating oil additives. Agricultural waste products and industrial by-products are being examined for possible value as compounding agents.

"The problem of compatibility of some of the established additive materials with certain oils is being studied. Failure of certain base oils to be benefited by the addition of certain accepted additives also is under study.

"In the past two years the Engine Research Laboratory has rendered service to the following sponsors: Alox Corporation, American Cyanamid and Chemical Company, Army Ordnance, Atlantic Refining Company, Calumet Refining Company, Chicago Motor Coach Company, Continental Oil Company, E. I. du Pont de Nemours & Company, Inc., Glidden Company, Gulf Research and Development Company, Imperial Oil, Ltd., Kendall Refining Company, Lion Oil Refining Company, Lubri-Zol Corporation, McColl-Frontenac Oil Company, Ltd., Mid-Continent Petroleum Corporation, North Star Oil, Ltd., Ohio Oil Company, Pure Oil Company, Quaker State Oil Refining Corporation, Radbill Oil Company, Shell Oil Company, Inc. (Eastern), Shell Oil Company, Inc. (Western), Sinclair Refining Company, Inc., Skelly Oil Company, Socony-Vacuum Oil Company, Spiegel, Inc., Standard Oil Company of California, Standard Oil Company of Indiana, Standard Oil Company of Ohio, Standard Oil Development Company, Texas Company, Thompson Products, Inc., Tide Water Associated Oil Company, Union Oil Company of



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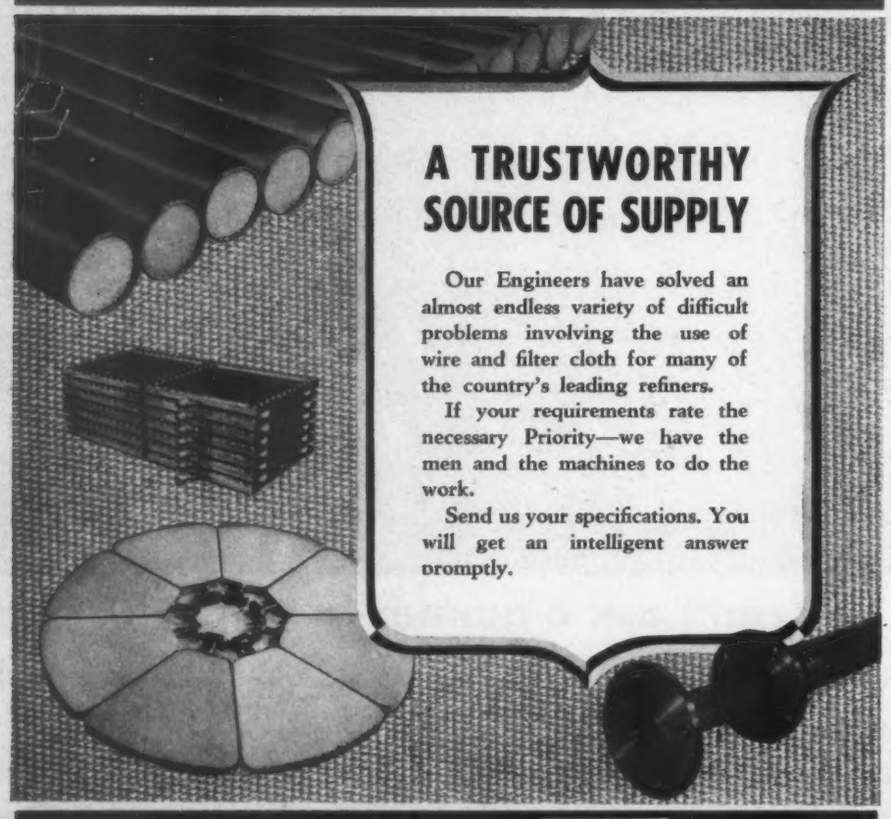

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California. The technique of used oil analysis has been given wide-spread study in which the Engine Research Laboratory has participated. Used oil from Diesel engines is difficult of analysis because of the detergent and dispersive qualities of the additive and the large amounts of lube oil oxidation products and soot from combustion of the fuel."

Suggestions for Solving Manpower Problems

From the studies of a special committee the Petroleum Industry War Council has issued specific recommendations for solving the many problems that arise from the shortage of manpower. The report has been put into phamplet form under the title "Oil Workers Are War Workers." The phamplet is ready for distribution to industry management.

The announcement of phamplet and the study that preceded it had this estimate of what management should do:

"And the most important step for every oil company in meeting manpower problems is to convince its employes that they are essential war workers, a fact that has been recognized by the Selective Service System and the War Manpower Commission, and that recently was stressed in a joint public statement by WMC Director Paul V. McNutt and Petroleum Administrator Harold L. Ickes."

The fourteen specific suggestions made by the committee are:

1. Establishment of a company employment pool.

2. Employment of women and older men, with examples of the types of oil-company jobs that women can fill.

3. Investigate the possibility of increasing the use of non-white employes.

4. Cease retiring employes who still are able to perform a job.

5. Search lists of former employes over 38 now in the armed forces, who may wish to return to your company under the provisions of recent regulations.

6. Do not attempt to persuade local draft boards to defer every employe. Use Form 42-A for key men and those in critical jobs only.

7. Encourage present employes to find new employes among relatives and friends.

8. Look for new employes among wives of young married men going into service.

9. Relax any rules that women who marry must resign.

10. Relax physical requirements to employ physically handicapped people for certain jobs.

11. Use the manning tables developed by the War Manpower Commission.

12. Exhaust all possibilities of upgrading, job breaking down and in-plant training.

13. Use every effort to obtain deferment for professional personnel, but do not overlook the possibilities of women for some jobs, such as laboratory assistants.

14. Smaller companies and individual operators should adopt similar policies modified to fit their size, planning in advance for replacement of employes.

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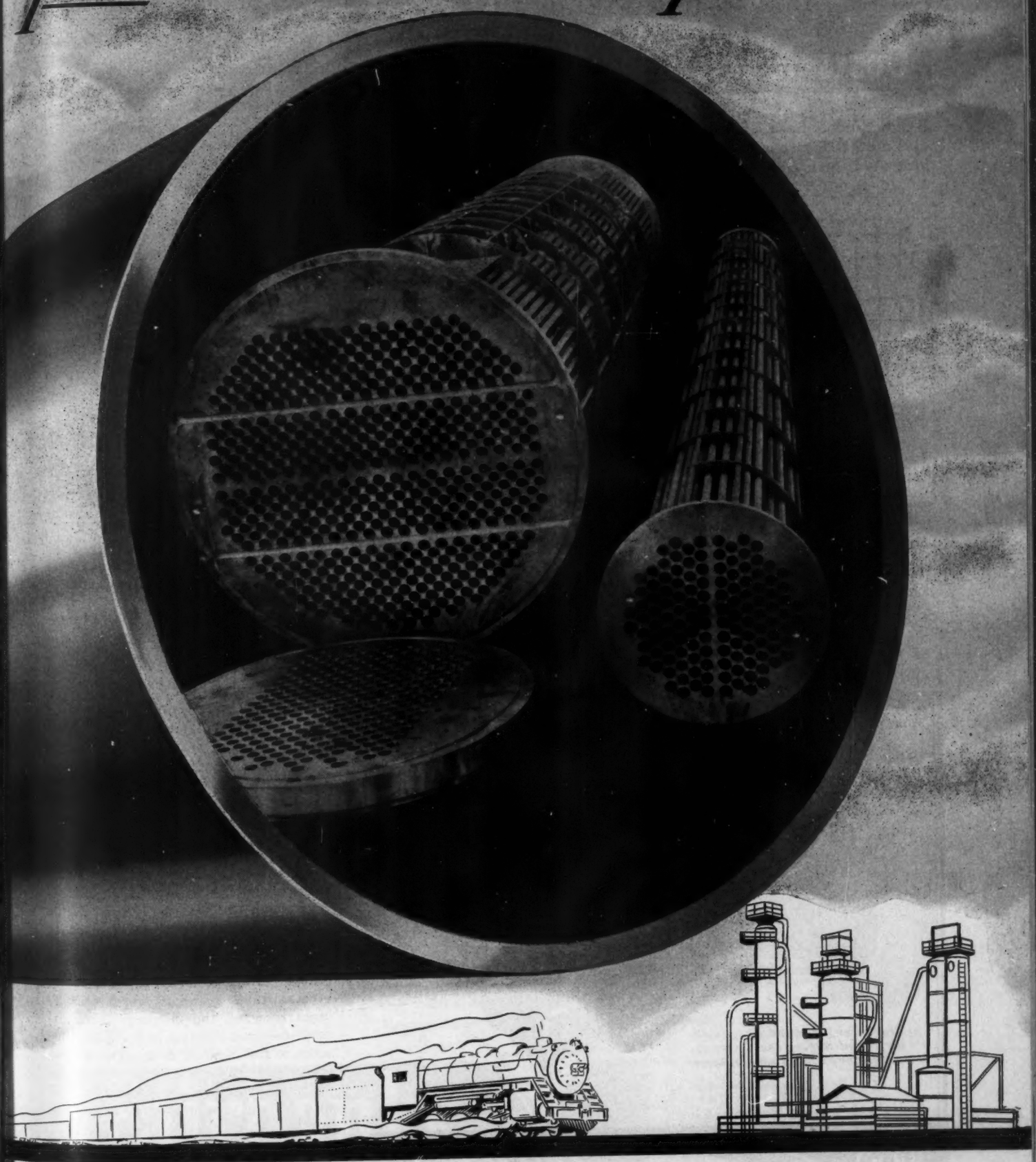

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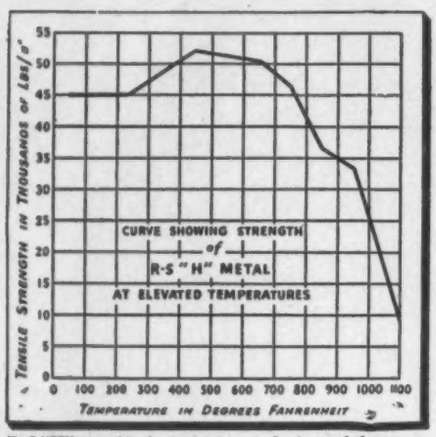

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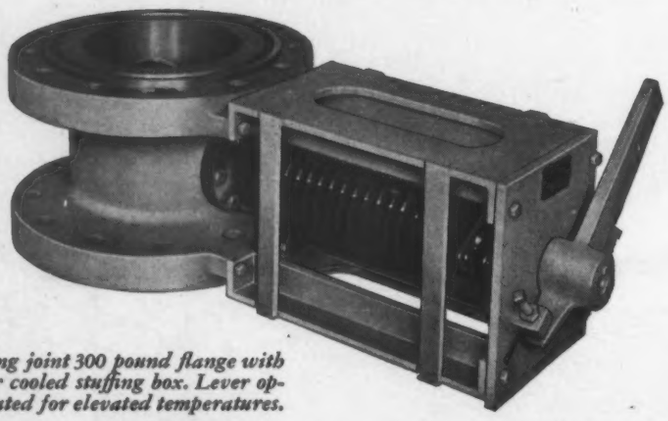

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API Reports Increase In Crude Reserves

The industry last week received its most encouraging estimate on the quantity of new petroleum supplies found and developed during 1942, when the American Petroleum Institute's Committee on Petroleum Reserves made public its annual report. The United States petroleum industry proved the existence of an additional 1,878,976,000 barrels of oil during the year, or 493,497,000 barrels more than the 1,385,489,000 barrels of crude oil produced during the year, according to the API study. The net increase raised the API's estimate of total known producible reserves remaining in the ground as of December 31, 1942, to 20,082,793,000 barrels, against a figure of 19,589,296,000 barrels a year previous.

Of four separate estimates made on 1942 exploratory efforts, the API is the only one to report that more crude oil reserves were found than the volume produced during the year. The other three having shown varying degrees of shortage.

This increase cannot be considered large when thinking in terms of billions of barrels, nor in view of the current high rate of consumption and prospects that demand will go much higher in the immediate future. Nevertheless, it is significant that additional underground supplies were discovered during a year when difficulties of every conceivable kind faced the industry, and that drilling activity was off more than 30 percent.

Although painting a much better picture of the nation's 1942 discovery efforts than the three previous reserve reports, the API figure still leaves the question of the industry to produce sufficient quantities to carry on national economy and military efforts in doubt, in view of vastly enlarged needs. Although more encouraging than the reserve estimates made by other sources, the API report still shows that there is a declining rate of the discovery during the past six years. Future requirements demand that reserves be great enough to allow increases in production without the waste which would follow any prolonged production at greater than optimum rate. Despite large reserves, the industry, therefore, must continue drilling new exploratory wells to find new oil fields. The decline in discovery rates, combined with the probable increases in demand, makes this drilling program more imperative now.

The API committee's 1942 report stressed the fact that its estimates of reserves do not reflect the availability or the rate at which these reserves can be produced. "For insance," the com-

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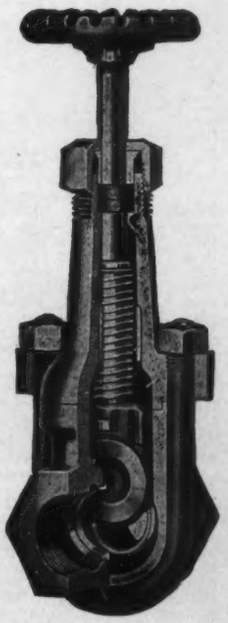

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mittee stated, "arbitrary division of the known reserves by a current rate of production or by any anticipated rate of consumption is obviously incorrect," and that "as a matter of fact, today's known oil can be recovered only over a period of many years and at gradually declining rates, as has been widely demonstrated by past performance under all kinds of operating conditions."

This is the soundest of advice and should be heeded earnestly by those people in our government responsible for seeing to it that materials and means are made available for whatever exploration for additional oil is necessary. This becomes of immediate importance, because it takes several years to develop a wildcat discovery to the point that the producing ability of the field attains its peak.

Most of the new oil the API credited to 1942 reserve additions was through upward revisions of estimated reserves in fields found prior to 1942. This was the result of further development of these older fields, which revealed a net addition of 1,618,925,000 barrels of crude oil which had not been included in previous estimates for these fields, but which is now indicated by additional development information. It is noteworthy that of the 1,878,976,000 barrels the committee estimates was found in 1942, that only 260,051,000 barrels were from new pools discovered during the year.

In discussing this situation, the committee report said: "It should be emphasized that the estimates in this report refer only to reserves proved by drilling and production performance. In the case of a new discovery, where only a few wells have been completed, estimates of the total quantity of oil contained in the pool, when made shortly after discovery of the pool, are hazardous and subject to considerable error. For this reason, a relatively small area is assigned to such a pool but not without full realization that subsequent drilling may extend the region and therefore the quantity of oil proved to be in the pool. The total of new oil estimated in this way in any given year will always be comparatively small and the total of new oil through extensions comparatively large. Again, as knowledge of the factors affecting production and well performance become available and are studied, reserves in older fields can be estimated with greater precision and revised accordingly. Thus we are dealing with es-

API Estimate of Proved Petroleum Reserves in the United States

(Barrels of 42 U. S. Gallons)

	Proved Reserves as of January 1, 1942 (December31,1941)	Proved New Reserves (Discoveries, Extensions and Revisions in 1942*	Production During 1942 (Bureau of Mines Preliminary)	Proved Reserves as of December 31, 1942 (Cols. 1+2 less 3)
	(1)	(2)	(3)	(4)
Arkansas	295,017,000	31,637,000	26,628,000	300,026,000
California	3,323,147,000	121,025,000	248,326,000	3,195,846,000
Colorado	23,443,000	18,220,000	2,220,000	39,443,000
Illinois	333,714,000	79,520,000	106,456,000	306,778,000
Indiana	22,873,000	15,643,000	6,743,000	31,773,000
Kansas	689,795,000	94,816,000	97,636,000	686,975,000
Kentucky	36,450,000	2,675,000	4,472,000	34,653,000
Louisiana	1,330,134,000	227,718,000	115,726,000	1,442,126,000
Michigan	55,620,000	29,977,000	21,754,000	63,843,000
Mississippi	80,207,000	—10,477,000†	28,833,000	40,897,000
Montana	86,124,000	7,508,000	8,074,000	85,558,000
Nebraska	4,014,000	—600,000†	1,237,000	2,177,000
New Mexico	674,817,000	34,224,000	31,544,000	677,497,000
New York	59,816,000	None	5,421,000	54,395,000
Ohio	37,404,000	1,160,000	3,543,000	35,021,000
Oklahoma	1,035,820,000	73,797,000	140,690,000	968,927,000
Pennsylvania	170,897,000	None	17,779,000	153,118,000
Texas	10,975,641,000	1,053,457,000	483,371,000	11,545,727,000
West Virginia	50,011,000	750,000	3,574,000	47,187,000
Wyoming	304,053,000	97,911,000	31,392,000	370,572,000
Miscellaneous‡	299,000	15,000	60,000	254,000
Total United States	19,589,296,000	1,878,976,000	1,385,479,000	20,082,793,000

*This column includes proved reserves discovered in new fields plus proved reserves added by extensions of pools only partly developed a year ago, plus or minus any revisions in former estimates. Only a limited area is assigned to each new discovery even though the Committee may believe that eventually a much larger area will produce, for in this report we are concerned only with actually proved reserves. See another table for breakdown of oil found in new fields and revisions and extensions.

† No discoveries; previous estimates revised downward.

‡ Includes Tennessee, Missouri, Utah and Virginia.

Summary of API Committee's Annual Reports Covering Period 1937-1942

(Barrels of 42 U. S. Gallons)

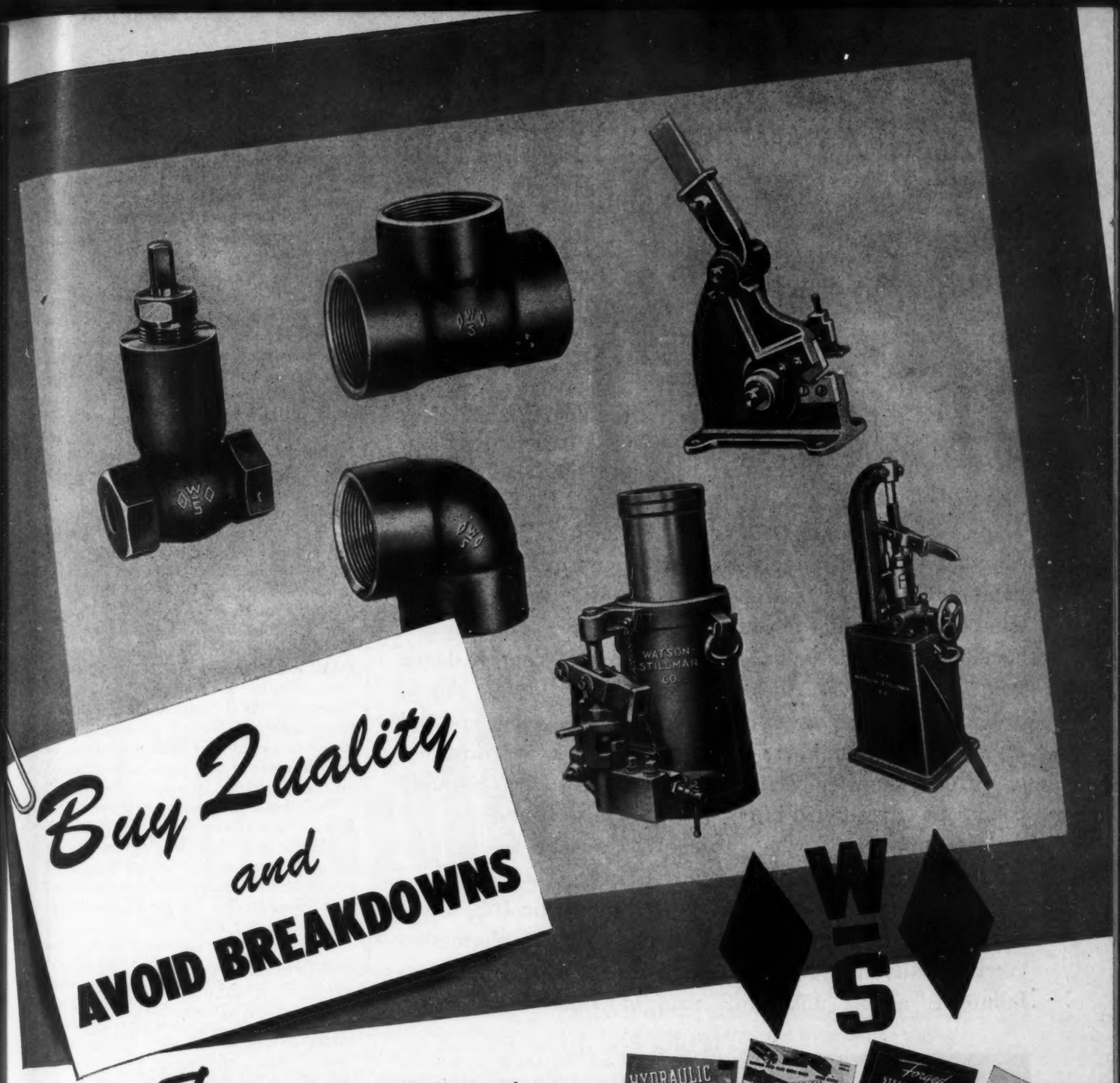
YEAR	New Oil Blocked Out During Year: Through Revisions of Previous Estimates and Extensions to Known Fields	Through New Pools Discovered During Year	Total Through New Discoveries, Extensions and Revisions	Production During Year	Estimated Proved Reserves as of End of Year
1937	2,792,790,000	928,742,000	3,721,532,000	1,277,664,000	15,507,268,000
1938	2,243,571,000	810,493,000	3,054,064,000	1,213,186,000	17,348,146,000
1939	2,058,455,000	340,667,000	2,399,122,000	1,264,256,000	18,483,012,000
1940	1,607,012,000	286,338,000	1,893,350,000	1,351,847,000	19,024,515,000
1941	1,538,989,000	429,974,000	1,968,963,000	1,404,182,000	19,589,296,000
1942	1,618,925,000	260,051,000	1,878,976,000	1,385,479,000	20,082,793,000

Comparison of API Estimates of Oil Found in 1942 and 1941 by States

	Through New Fields Discovered During Year		Through Revisions of Previous Estimates and Extension of Fields		Total Through New Fields, Extensions and Revisions	
	1942	1941	1942	1941	1942	1941
Arkansas	19,706,000	9,535,000	11,931,000	5,591,000	31,637,000	15,126,000
California	5,195,000	18,750,000	115,830,000	243,278,000	121,025,000	262,028,000
Colorado			18,220,000	2,095,000	18,220,000	2,095,000
Illinois	14,281,000	62,946,000	65,239,000	89,601,000	79,520,000	152,547,000
Indiana	780,000	1,926,000	14,863,000	13,878,000	15,643,000	15,804,000
Kansas	14,719,000	23,673,000	80,097,000	57,295,000	94,816,000	80,968,000
Kentucky	2,675,000	213,000			2,675,000	213,000
Louisiana	42,110,000	47,915,000	185,608,000	182,668,000	227,718,000	230,583,000
Michigan	6,120,000	27,330,000	23,857,000	10,072,000	29,977,000	37,402,000
Mississippi		1,000,000	—10,477,000	54,279,000	—10,477,000	55,279,000
Montana	200,000		7,308,000	4,207,000	7,508,000	4,207,000
Nebraska		1,550,000	—600,000	351,000	—600,000	1,901,000
New Mexico	16,340,000	1,201,000	17,884,000	20,844,000	34,224,000	22,045,000
New York						
Ohio	1,160,000	3,660,000		6,800,000	1,160,000	10,460,000
Oklahoma	26,897,000	58,911,000	46,900,000	129,759,000	73,797,000	188,670,000
Pennsylvania						
Texas	108,653,000	170,364,000	944,804,000	689,345,000	1,053,457,000	859,709,000
West Virginia		1,000,000	750,000		750,000	1,000,000
Wyoming	1,200,000		96,711,000	28,926,000	97,911,000	28,926,000
Miscellaneous	15,000				15,000	
	260,051,000	429,974,000	1,618,925,000	1,538,989,000	1,878,976,000	1,968,963,000

Comparison of API and PAW Proved Reserve Estimates

	ESTIMATED NEW RESERVES	
	By A.P.I. In Fields Discovered in 1942	By P.A.W in Fields and Horizons Discovered in 1942
Arkansas	19,706,000	20,600,000
California	5,195,000	11,165,000
Illinois	14,281,000	15,034,250
Indiana	780,000	968,800
Kansas	14,719,000	14,593,805
Kentucky	2,675,000	1,440,500
Louisiana	42,110,000	16,278,000
Michigan	6,120,000	3,585,300
Montana	200,000	80,000
New Mexico	16,340,000	880,000
Ohio	1,160,000	78,000
Oklahoma	26,897,000	36,620,305
Texas	108,653,000	57,177,000
Wyoming	1,200,000	1,479,440
Miscellaneous	15,000	
Total U. S.	260,051,000	178,420,960



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Parts of cracking still equipment subject to corrosive conditions and high temperatures require replacement ultimately. When failure occurs, not only is the cost of the new part involved, but where operation is continuous there is also a costly production delay. Many cracking still operators have minimized these replacements and delays by installing Amsco Alloy castings to withstand the corrosion and high temperatures. Amsco Alloy is available in a number of analyses to meet the entire range of corrosion and temperature conditions encountered in petroleum processing.

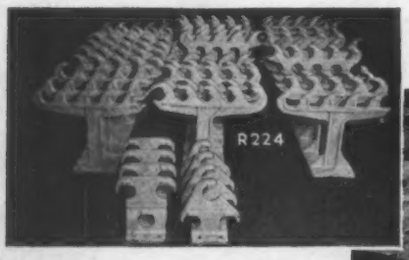
Amsco Alloy F-10 tube supports and hangers have proved so well suited to service in cracking stills that premature failure is almost unknown.

This highly corrosion-resistant alloy contains 26 to 28% chromium and 10 to 12% nickel. It has a load-carrying strength at 2100° F. that permits the greatest economy in design. Its residual ductility, when cold after a service run, avoids breakage when tubes are replaced.

Refinery applications of Amsco Alloy parts include tube supports, drum liners, brick hangers, damper doors, guide hooks, tube sheets, burner nozzles, hangers and bars. The long service rendered by these parts not only makes them economical, but helps to conserve less suitable metals.

Write for Bulletin 108, which contains complete information on Amsco Alloy and illustrates many of its applications.

R-224—a ton lot of Amsco Alloy Grade F-10 tube supports and (R-554) a 40-ton shipment of another of the many types of supports we are called on to make.



Junk Your Scrap NOW!

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

THE AMERICAN Brake Shoe AND FOUNDRY COMPANY

sentially known data in making these estimates of reserves."

The report gave no consideration of the reserves which may be found in areas known to be favorable to the accumulation of oil but which are yet are untested.

Because of differences in type of reserve data contained in the two reports it is difficult to compare the API reserve estimate with the recent one released by the Petroleum Administration for War. The PAW report did not include additions to reserves resulting from extensions to fields discovered prior to 1942, which the API study includes. The PAW report attempted to calculate reserves in so-called "proved undrilled" areas, while the API included only the "proved drilled" territory. Consequently, the only comparison to be made is between the API "estimate of reserves contained in new fields discovered in 1942" and the PAW "estimate of reserves in new fields and new horizons discovered in 1942 that have been proved by drilling," which PAW calls "proved producing." In this connection the PAW report carried this statement: "It is believed that the total figure shown as 'proved producing' corresponds essentially with the figure of 'new reserves in new pools' as estimated by the American Petroleum Institute." On this basis the two reports are fairly well in agreement, except for Texas, Louisiana and New Mexico, as shown by an accompanying table. The API report credited new fields in these states with considerably larger proved reserves than did PAW.

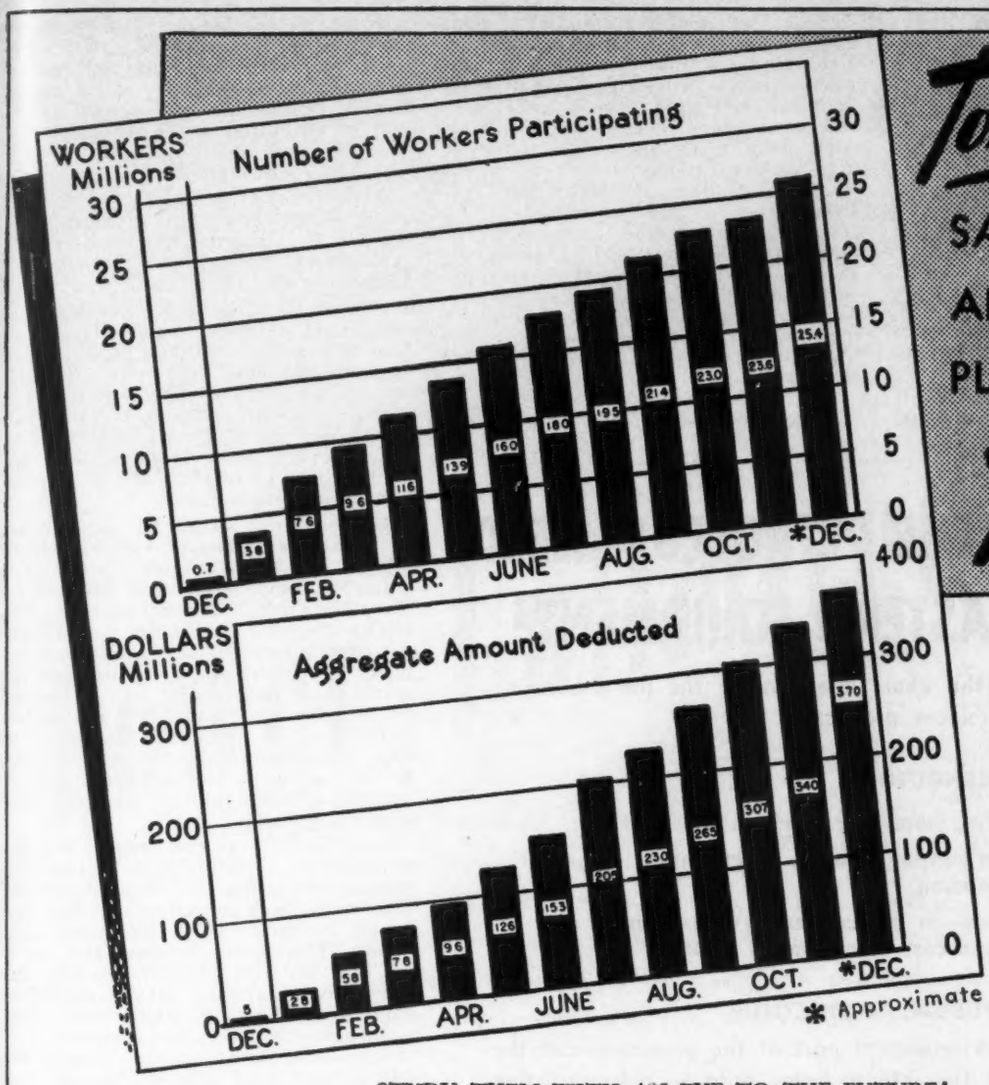
Most of the new oil found during the year was in Texas, where 1,053,457,000 barrels of the 1,878,976,000 barrels was located, according to the API. This compared with the discovery of 859,-709,000 barrels in this state during 1942. The increase was due to extension of previously found fields, for new fields in the state were credited with less oil than those opened during 1941, but nevertheless accounted for 108,653,000 barrels of the 260,051,000 found in the nation. Texas' 1942 volume of new oil found was more than twice its production of 483,371,000 barrels, and consequently its remaining reserves climbed to 11,545,727,000 barrels.

Officials Elected for Pennsylvania Company

Paul R. Beck has been elected vice president of Pennsylvania Refining Company, Butler. At the same time John Beck, Jr., was elected secretary and treasurer.

Officials who were reelected are Walter W. Beck, M. H. Hindman and Dale T. Glenn, vice presidents. Dale is in charge of the Ohio division.

The company has plants at Titusville and Karns City, Pennsylvania.



Tomorrow's SALES CURVES ARE BEING PLOTTED . . . Today

THESE CHARTS SHOW ESTIMATED PARTICIPATION IN PAYROLL SAVINGS PLANS FOR WAR SAVINGS BONDS *(Members of Armed Forces Included Starting August 1942)*

STUDY THEM WITH AN EYE TO THE FUTURE!

There is more to these charts than meets the eye. Not seen, but clearly projected into the future, is the sales curve of tomorrow. Here is the thrilling story of over 25,000,000 American workers who are today voluntarily saving close to FOUR AND A HALF BILLION DOLLARS per year in War Bonds through the Payroll Savings Plan.

Think what this money will buy in the way of guns and tanks and planes for Victory today—*and mountains of brand new consumer goods tomorrow.* Remember, too, that War Bond money grows in value every year it is saved, until at maturity it returns $4 for every $3 invested!

Here indeed is a solid foundation for the peace-time business that will follow victory. At the same time, it is a real tribute to the voluntary American way of meeting emergencies that has seen us through every crisis in our history.

But there is still more to be done. As our armed forces continue to press the attack in all quarters of the globe, as war costs mount, so must the record of our savings keep pace.

Clearly, on charts like these, tomorrow's Victory —*and tomorrow's sales curves*—are being plotted today by 50,000,000 Americans who now hold WAR BONDS.

Save with War Savings Bonds

This space is a contribution to America's all-out war effort by

PETROLEUM REFINER

Further Adjustment in Refinery Yields Urged

A "serious situation" will result if refinery yields are not adjusted quickly to increase supplies of fuel oil and reduce those of gasoline, PIWC members were warned at their March meeting by its Committee on Petroleum Economics. The necessary impetus to adjust yields can be given only by adoption of a gravity premium price program, the committee said, which it pressed Administrator Ickes to urge upon OPA. Shortly afterwards, OPA announced establishment of such a program for the area east of the Rocky Mountains.

Discussions during the two-day meeting covered a wide range of subjects, and the council adopted a series of resolutions dealing with matters of immediate concern. Included in these was a resolution attempting to allay fears that big companies would take over emergency pipe lines after the war, while another urged establishment of tubular goods pools in selected areas so they would be available for emergency and wildcat operations. The council also made the acquaintance of New Price Administrator Prentiss M. Brown, who, while he did not discuss oil questions specifically, gave unmistakable intimations that his approach to the industry's problems would differ from that of his predecessor, Leon Henderson.

The committee report did not contain the 1943-44 forecast which had been promised, due to inability to secure revised figures for military requirements. However, that information will be available shortly, and a projection of possibilities for at least a year will be submitted at the April meeting.

Refinery Yields

The general situation in Eastern, Midwest and Southwest districts was a matter of concern to the committee, especially the problem of refinery yield adjustments.

"There is, in Districts 1, 2 and 3, a definite tendency towards overproduction of gasoline and underproduction of kerosine, distillate and residual fuel oils, particularly the latter," it was declared. "Stock levels of gasoline in both Districts 1 and 2 are above necessary minimum working levels, while in both districts stocks of residual fuel oil are below desired minimums.

In District 3 stocks of gasoline are at high levels causing serious inflexibility in war product production, whereas stocks of residual fuel oil are close to minimum requirements. Preliminary forward estimates for remainder of this year indicate that unless refinery yields in all three districts are markedly adjusted there will be serious over-production of gasoline and underproduction of fuel oils necessary to meet export military requirements and to build adequate stocks of fuel oil during the coming summer to meet next winter's demand.

Last October at the time of the announcement of nation-wide gasoline rationing, the committee pointed out the drastic changes in refinery yields that would be required to supply requirements of kerosine, distillate and residual fuel oils with gasoline demand curtailed under rationed conditions. While some adjustments of yields have taken place since that time it is apparent from the present stock situation that those adjustments have been inadequate. The primary reason while the necessary adjustments have not been made, has been the lack of adjustment in the rigid product price ceilings to encourage the production of fuel oils at the expense of gasoline."

The report pointed out that recently OPA made provision for adjustment in fuel oil prices in certain areas in Districts 2 and 3 to encourage residual fuel oil production at the expense of gasoline and urged its extension to the whole country. Shortly after the report was written, OPA announced that it had established gravity premiums for the area East of the Rocky Mountains.

However, it was stressed, the gravity premium was not offered as a substitute for over-all price increases and pointed out that this method "which the committee has for some time advocated as the most effective and equitable means of providing an incentive for increasing fuel oil production, can be applied on any existing level of overall product prices.

"It might be pointed out that necessary yield changes could be less drastic, and over-crowding of bus and other public transportation facilities reduced if the present restrictions on passenger car use, particularly in the East, could be somewhat relaxed, as soon as adequate heating oil supplies are assured." the committee added. "This will be largely controlled by the extent of future military requirements which will be developed in the committee's long-

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Eastern Mixers—the whole line—are on the job processing the nation's petroleum products.

IN GASOLINE BLENDING

- **A safer, more efficient fuel.**
- **Faster output through thoroughness of blending.**
- **Savings—in power, less evaporation, and the cost of additional tanks.**

IN SYNTHETIC RUBBER PRODUCTION

. . . Mixing is an important part of the process—from the first blending of the intermediates prior to polymerization down to the final mixing of the synthetic latex. Put Eastern Mixers on the job—this equipment has been tried and proved by many important producers.

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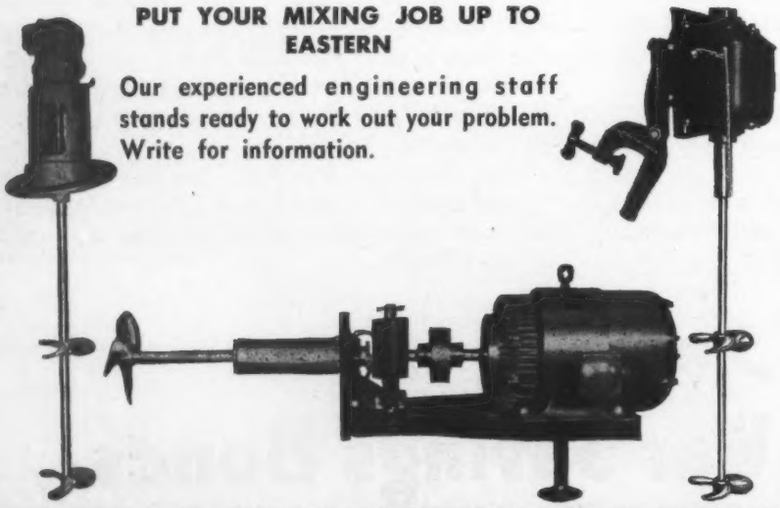

EASTERN ENGINEERING COMPANY

55 FOX ST., NEW HAVEN, CONN.

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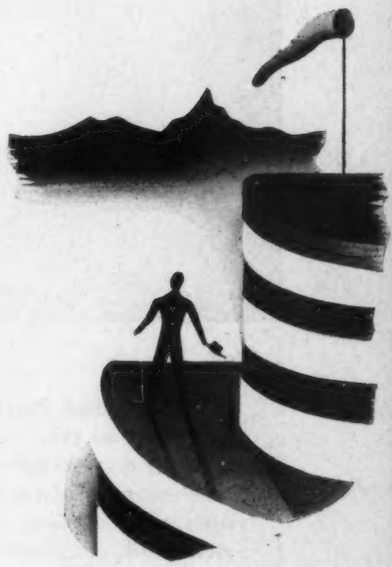
Close on the heels of the "perfect 100" octane rating for gasoline, come reports of a "rich mixture" fuel that will make possible tomorrow's faster, more powerful planes. It's too much for present engines to handle. But it has one big job today—the enriching of lower octane gasoline so that the United Nations can maintain their aviation margin over the Axis in speed, range and load capacity.



It is not hard to envision the future expansion necessary before the petroleum industry can give the fruits of its wartime research accomplishments to a world at peace. In this expansion OSTUCO will be ready to contribute as it has to previous developments in the petroleum industry. Seamless steel tubing will be required from well to finished product, for diamond drill rods, core barrels, shell forgings, heat exchangers, condensers and other applications. You'll find OSTUCO experience, greatly enriched by manufacture to rigid wartime specifications, offering advantages that will be reflected in lower production costs, increased production speed.

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BUY U.S. WAR BONDS

THE OHIO SEAMLESS TUBE COMPANY

SHELBY OSTUCO OHIO

term report to be submitted at the next council meeting."

The council sought to present a united front on the 20-inch line itself, adopting a resolution recommending that Ickes immediately petition for allocation of the necessary steel and critical materials to complete it to the East Coast. Less than 24 hours later, the administrator told a Senate investigating committee that the applicaion had already been filed with WPB.

PIWC based its resolution on findings that while the combination of East Coast domestic and offshore demands this season was far in excess of supplies, necessitating heavy drafts on stocks which reduced the amount to critical and dangerous levels, indications are that demand next winter will be still greater. The existing and presently projected transportation facilities will not permit any material additions to stocks this summer, it warned, and "failure to build up requisites to checks will invite a recurrence of serious shortages of petroleum products for civilian needs and may interfere with regular and orderly supply of petroleum products to the military." Submitting the report of the economics committee, Dr. Robert E. Wilson, chairman, gave no figures on the current situation, but quoted API index figures showing an improvement in stocks and told the council that "while local shortages will still have to be contended with during the month of March, particularly on kerosine, distillate and residual fuel, it is believed that we are "over the hump" and that, on the whole, except for residual fuel oil, even local shortages should be avoided after early March.

Spurred by the controversy over the 20-inch products line, the council sought to allay fears that the war-necessitated pipe lines would be sold to the large companies upon the conclusion of the war, and in a resolution recommended that "at the end of the tanker-emergency and/or the end of the war, but not later than six months after the war, PAW or its successor agency call into conference the petroleum industry in Districts 1, 2 and 3, to determine the disposition and future use of all oil pipe lines built with government money."

Establishment of tubular goods polls in selected areas, to permit supply companies to assemble essential materials for the use of operators in areas where they may be immediately available for emergency and wildcat operations, was urged in a resolution in which it was declared that the WPB program requiring the production branch to indicate its requirements of tubular goods "runs contrary to industry custom with relations to the smaller independent producers and contractors and would require greatly increased stocks."

In addition to separate stock piles for individual operators it was pointed out pools of tubular goods could be established in the various supply company stores for distribution under PAW direction.

Classification of all branches of the industry, but particularly distribution, as essential of the war program, was urged in another resolution which pointed out that among many government agencies, and particularly the local selective service and ration boards, "There exists a widespread feeling that the distribution branch of the petroleum industry is a non-essential branch of what is admittedly an essential industry."

In a companion resolution, the council urged that PAW secure reversal of OPA rulings denying supplemental gasoline rations to field managers and other employes of oil companies required to travel from plant to plant, supervise activities in the field, etc., on the ground that these are essential activities.

Dealing with the marketing situation, the council urged an increase of not less than one cent a gallon in retail gasoline price ceilings, half of which would be allocated to the jobbing function to partly cover the increased costs of rationing; recommended a national elimination of all traffic regulations, including stop lights and signs, which are unnecessary for safety under the present reduced traffic, and suggested that OPA permit oil dealers to fill consumer's heating oil tanks this summer to ease the strain on their delivery services next winter and to keep in efficient operation truck equipment which otherwise will be laid up until fall.

J-M Moulded Packing Cups are made to take the toughest kind of service on all types of slow-moving pistons and rams operating against air, water, steam, oil, etc. Even against extremely high pressures and temperatures they stand up in service and assure a positive seal with minimum friction.

J-M Moulded Cups are "custom-made"... moulded to the exact shape and size required. Their composition can be varied to meet specific service conditions. For details on Moulded Packing Cups and on the complete line of J-M Packings, ask for the J-M Packing Catalog. Johns-Manville, 22 E. 40th Street, N. Y. C.

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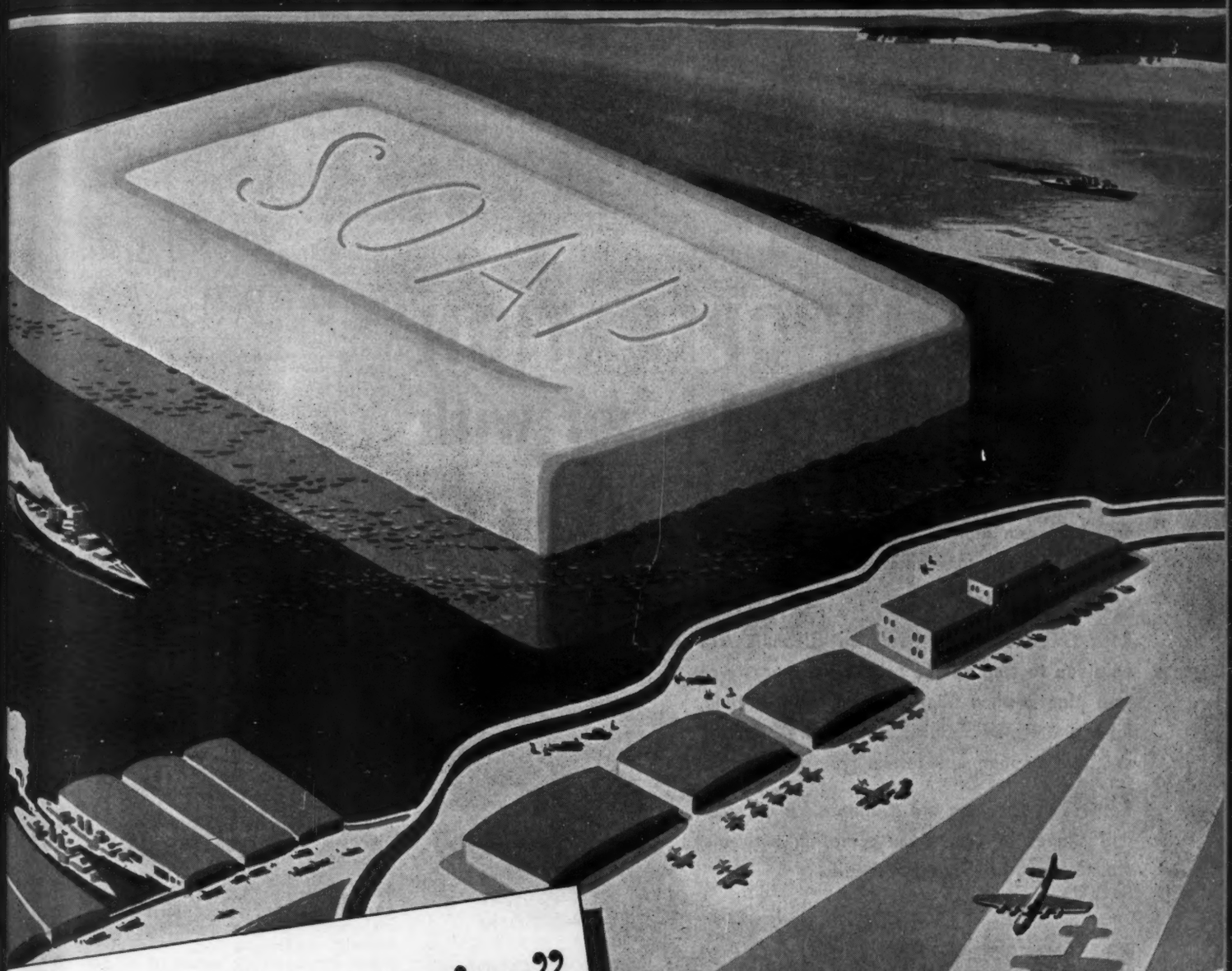
Johns-Manville PACKINGS & GASKETS
THERE'S A DISTRIBUTOR NEAR YOU

Former Vice President Of Atlantic Dies

Richard Dunlop Leonard, retired vice president and a former member of the board of directors of the Atlantic Refining Company, died February 1 at his home in Ardmore, Pennsylvania. He was 64 years old. He was a native of Philadelphia and a graduate of the University of Pennsylvania.

DOW CAUSTIC SODA



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Dow has production facilities strategically located to serve this and other vital industries. Thus availability—plus quality and uniformity—make Dow a preferred source of supply. Inquiries will receive prompt attention.

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CHEMICALS INDISPENSABLE TO INDUSTRY AND VICTORY

March Demand Eight Percent Above 1942

Despite gasoline and fuel-oil rationing, market demand in March will call for the production of 3,912,900 barrels of domestic crude daily, an increase of 274,900 barrels, or 8 percent, over actual production in March, 1942, it was disclosed by the Bureau of Mines.

Bureau figures for the final quarter of 1942 show a total actual demand for motor fuel of about 150,300,000 barrels, daily average crude runs of 3,718,000 barrels, and a daily average demand for domestic crude of 3,934,000 barrels. Compared with the forecasts, it was stated, total motor fuel demand was 2 percent greater than estimated and crude runs and the demand for domestic crude exceeded the forecast by less than 1 percent.

"On the basis of available current data," the bureau said in discussing the general situation, "it now seems probable that total gasoline demand during the first quarter of 1943 may be about 3 percent less than forecast and the demand for domestic crude petroleum may be from 1 to 2 percent below the amount estimated. This decline in expected demand can be attributed primarily to the ban on non-essential driving in District 1, effective after the issuance of the forecast for January, to reductions in the value of heating-oil coupons, and to other reductions in consumption of all oils necessitated by the strain on overland transportation facilities.

"The demand for domestic crude petroleum in 1943 is dependent on the extent to which the curtailment in civilian motor-fuel and fuel-oil consumption is offset by increases in war requirements and exports, on the trend of imports and on changes in total stocks. Possibly the clearest factor, at the present time, is that the 1942 reduction of over 58,000,000 barrels in stocks of all oils cannot be repeated. If the total demand for all oils and imports in 1943 should approximate the 1942 levels and there were no withdrawals from total stocks, an increase of about 4 percent in crude production would be required."

The bureau reported that daily average crude production during the four weeks ended February 6 was 3,844,000 barrels, and total runs to stills 3,661,000 barrels, while stocks of domestic crude increased at the rate of 11,000 barrels daily, indicating a demand for domestic crude of 3,833,000 barrels a day.

Total demand for motor fuel this month is estimated at 45,600,000 barrels.

Stocks of finished and unfinished gasoline amounted to 80,126,000 barrels at the close of last year, and American Petroleum Institute figures indicate an increase of about 7,200,000 barrels during January, bringing the total on January 31 to approximately 87,300,000 barrels, about 13,900,000 barrels less than on the same date in 1942.

Direct sales of natural gasoline are estimated at 1,700,000 barrels, making an indicated refinery production of 47,500,000 barrels, which the bureau allocated among the several refining districts as follows: East Coast, Inland Texas, Texas Gulf Coast and inland Louisiana-Arkansas, 20,410,000 barrels; Appalachian, 1,990,000 barrels; Indiana, Illinois, Kentucky, etc., 10,700,000 barrels; Oklahoma, 2,400,000 barrels; Kansas, 2,760,000 barrels; Rocky Mountain, 1,350,000 barrels; California, 7,890,000 barrels.

Natural gasoline to be blended at refineries was estimated at 4,950,000 barrels; the estimated 37 percent yield, applied to the straight-run and cracked gasoline production of 42,550,000 barrels, gives total crude runs of 115,000,000 barrels, or 3,790,700 barrels daily. Crude for export and to be used as fuel, and losses, is placed at 6,400,000 barrels, making a total estimated demand for domestic crude of 121,300,000 barrels, or 3,912,900 barrels daily.

Wilson Takes Charge Of All WPB Programs

Charles E. Wilson, former president of General Electric Company, was named executive vice chairman of the War Production Board in February. His elevation into a place where he has authority of all phases of programs and activities of the agency followed the resignation of Ferdinand E. Eberstadt, program vice chairman.

In announcing the change Donald R. Nelson, WPB chairman, said:

"I have made this move in order to solve organizational problems which have come about because carefully scheduled production is now the most pressing problem before us.

"It is my conviction that this change will bring harmony to WPB and end the jurisdictional questions which, if permitted to continue, could only hamper the war effort.

"Mr. Eberstadt has worked hard and diligently in setting up the Controlled

ONE-MAN OPERATION
Saves time and labor with ROTO TUBE CLEANERS

No helper is needed with a Roto Tube Cleaner. One man can handle a tube cleaning job by himself with the convenient Roto Operating Air Valve on the motor.

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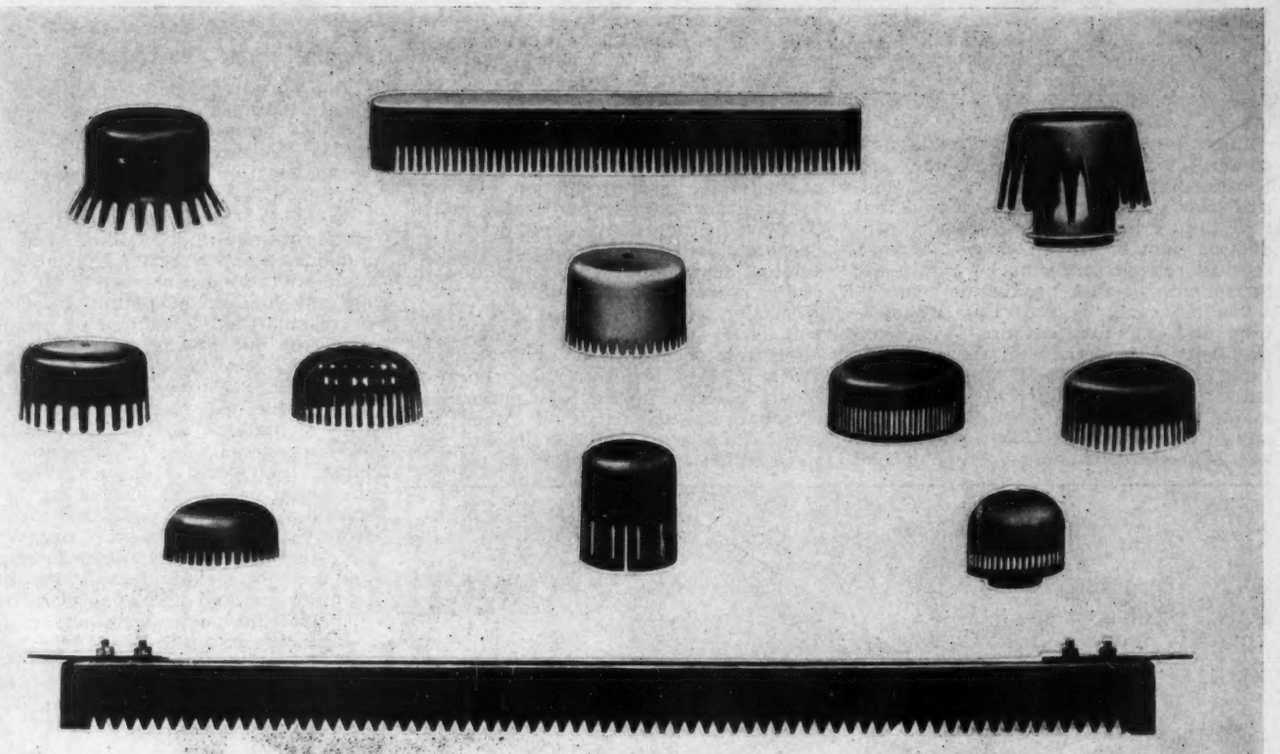

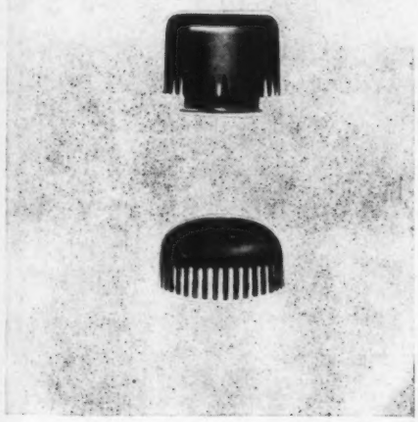

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Materials Plan, and I regret the circumstances which make it necessary for me to transfer his functions to another. However, Mr. Wilson is a production man, and our job today is primarily a production job.

"Because our entire effort must now center about the production line, and because this involves the closest control over scheduling, it is essential that two things be true—first, that a production man be in full charge; second, that all related problems be within the jurisdiction of that production man.

"In the early days of this organization and its predecessors, we faced problems of a somewhat different nature. Even a few months ago, the problem of controlling materials flow was of major importance. It does not now lose any of its importance, but the emphasis has shifted; scheduling — both of end items and components—is the overall job of first importance that must be pushed.

"And because the total war program has become more closely integrated, it follows that the man in charge of production cannot discharge his duties adequately unless he also controls the flow of materials into production channels.

"In other words, materials control and production control today are all one integrated job. They cannot be considered separately. They must be directed as one job, not two.

"Under my supervision, Mr. Wilson will have full authority to make the necessary decisions to carry out the WPB production programs for aircraft, escort vessels, rubber, high octane gas, merchant vessels and all other war items. I am confident that he will continue to keep production going up."

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THE REFINERY CATALOG

A COMPOSITE CATALOG OF OIL REFINERY EQUIPMENT

WPB Limits Ratings on Petroleum Products

A prohibition against the use of preference ratings to secure any of seven specified petroleum products was issued by WPB March 3 to avoid conflicts with allocation and rationing programs of the OPA and PAW.

Listed as products for which preference ratings might not be used were: liquefied petroleum gases, aviation gasoline, motor fuel; lubricating oil, including any finished or unfinished, distilled or residual liquid fraction of petroleum used for lubricating, which does not contain in excess of 50 percent (by weight) of additives or blending compound; fuel oil, including grades Nos. 1 to 6, bunker "C," diesel fuels, kerosene, range oil, gas oil and any other liquid petroleum product used for the same purposes; lubricating grease, meaning any lubricant manufactured from petroleum and a soap, organic salt or ester of any fatty oil or fatty acid; and asphalt, including asphalt of petroleum origin and all asphaltic products of petroleum origin, including road oils.

The only exceptions to the order are the purchase, sale or delivery of fuel oil for use in ocean-going vessels, or under regulations or orders which may hereafter be issued.

Procedure for Handling Oil Movement Cost Adjustments

Procedure for the handling of claims for compensation on oil acquired in Districts 2 and 3 and shipped into District 1 was set up by ODT March 3, with an announcement that it would issue certificates of request for in-trasit-handling to oil companies and other eligible for compensatory adjustments covering wartime costs of moving oil and products by substitute methods.

The certificates are issued under Regulation No. 1 of the Defense Supplies Corporation, and applications should be made to Fayette B. Dow, director of the division of petroleum transport.

The DSC regulations define persons eligible for adjustments as: "a person who produces, manufactures, acquires or purchases crude or compensable poducts in Districts 2 or 3 and imports the same, by substitute method of transportation, for manufacture or sale within District 1, or who makes a compensable intra-district movement" or "any person who, during the 12-month period ending June 30, 1941, regularly imported compensable products for his own consumption within District 1, and who imports, by substitute method of transportation, compensable products from Districts 2 or 3 for his own consumption in District 1."

The regulations relating to certificates of request are as follows:

"If in-transit-handling is incurred by applicant under the substitute method of transportation on or after January 1, 1943, then the normal cost of in-transit-handling shall be deducted from the applicant's claim and the substitute cost of in-transit-handling may be included in such applicant's claim, provided such in-transit-handling was incurred pursuant to the prior written request of the Office of Defense Transportation.

"If in-transit-handling is or has been incurred by an applicant under the substitute method of transportation prior

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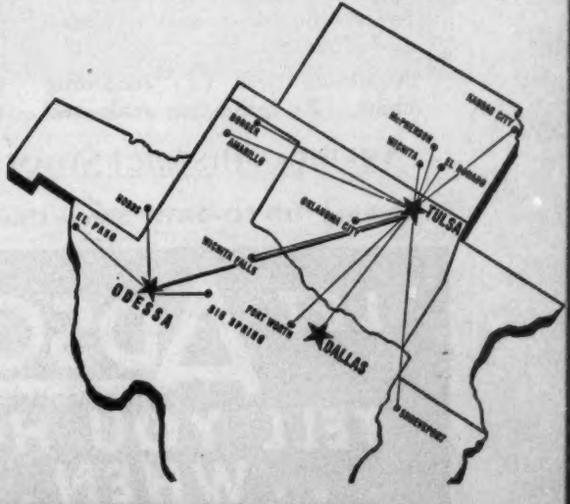

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Dallas and Odessa, Texas

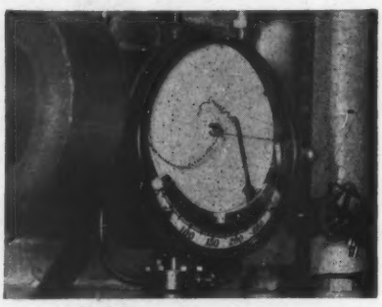
GET THIS HOUR BY HOUR RECORD *Totalized Every Day*

KEEP ACCURATE COSTS FOR STEAM, WATER, COMPRESSED AIR OR GAS

Get the data you need for allocating costs from these direct-reading, evenly-divided charts —recorded with exceptional accuracy at all rates of flow and TOTALIZED on the ADSCO Flow Meter.

Despite its high sensitivity to fluctuation in flow, the ADSCO Flow Meter is so simple and rugged that it cannot be damaged by sudden overloads or reverse flows—is easy to install and maintain.

Available with (1) recording chart, (2) indicating scale and (3) integrator counter to totalize the flow or other combinations thereof. Write us regarding your metering problems—also ask for Bulletin 35-83CM.



AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 years

LET ADSCO FLOW METER TELL YOU HOW MUCH . . . WHEN . . . WHERE

to January 1, 1943, then the normal cost of in-transit-handling shall be deducted from the applicant's claim and the substitute cost of in-transit-handling included by such applicant in his application filed hereunder, provided such in-transit-handling was incurred pursuant to the request of the Office of Defense Transportation or the Office of the Petroleum Coordinator for War (now Petroleum Administration for War) and the inclusion thereof is approved by the Office of Defense Transportation."

Natural Gasoline Stocks Drop; Production Gains

Production of natural gasoline and allied products increased in 1942 over the preceding year, reaching 3,509,814,000 gallons against 3,395,910,000 gallons, it is shown by the monthly December report of the Bureau of Mines.

The bureau announced that December production increased to an average of 10,183,000 gallons daily from 10,018,000 in November, as a result of outstanding gains in Texas Panhandle, California and Louisiana.

December production, it was stated, included 170,058,000 gallons of natural gasoline against 167,790,000 in November; 57,834,000 gallons of cycle products, against 55,902,000 gallons; 10,332,000 gallons of iso-butane at natural-gasoline and cycle plants, against 11,424,000 gallons; 77,448,000 gallons of liquefied petroleum gas at natural-gasoline and cycle plants, against 65,436,000 gallons, and 20,160,000 gallons of liquefied refinery gas at refineries, against 17,094,000 gallons.

Total stocks decreased during the month, those at plants and terminals dropping from 122,640,000 to 114,786,000 gallons and those at refineries from 87,192,000 to 79,758,000 gallons, the bureau reported.

Manager of Plant at El Segundo Dies

H. C. Hanna, manager of the El Segundo plant of Standard Oil Company of California, died February 18. He had been connected with the plant from its construction until his death.

Hanna, a native of Franklin, Pennsylvania, came to El Segundo in 1911 while construction was under way. His first employment was in the boiler shop. Later he became foreman of operations. January 1, 1922, he became assistant superintendent and four years later was promoted to superintendent. He became manager January 1, 1931.

Harry G. Seidel Killed In Clipper Crash

Harry G. Seidel, European representative of Standard Oil Company, (New Jersey), coordinator of marketing outside the United States and Canada, was lost in the crash of the Yankee Clipper at Lisbon, Portugal, on February 22nd. He was 52 years old.

Mr. Seidel, a native of Fitchburg, Mass., and a graduate of Brown University, had been with the company for 33 years.

In the first World War he remained in Bucharest during the German occupation of Roumania, the only American to stay in that city. Later he was captured by the Germans.

All Shapes and Sizes!

THE refractory shapes needed to construct a furnace lining of fire brick or tile are as varied as the shapes on a public beach—and a lot harder to find. But every shape under the sun is readily formed when you use:

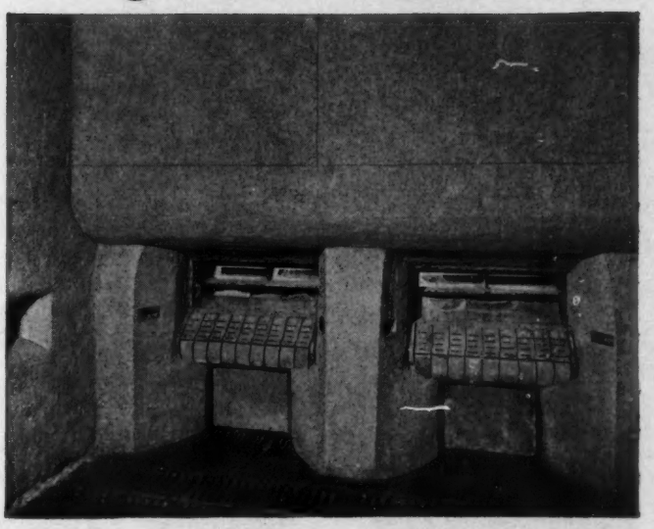
PLIBRICO
Jointless FIREBRICK

PLIBRICO eliminates all fancy tile and other special shapes. This moist, plastic material can be readily moulded to any shape or contour. It is ideal for repairing or rebuilding door openings, burner rings, arches, complete walls, etc. Within a few hours, you can have your furnace back in service again.

It's as if every carton of Plibrico contained an endless variety of special shapes—but far better, of course, because the finished Plibrico lining is completely free of the weak joints that couse breakdown, heat loss, and infiltration when laid-up fire brick is used.

The Plibrico idea of highest-quality refractory in monolithic form has made Plibrico Jointless Firebrick first choice of experienced refinery men for both boilers and stills. And today these basic advantages of Plibrico construction are multiplied by the fact that it eliminates all special shapes and is immediately available.

Where a castable material is desirable, we also offer Plicast refractories. This material is used for casting a reserve supply of special shapes in moulds; also for forming special shapes on the job.



Plibrico lining and suspended ignition arch in connection with spreader-type stoker; showing how Plibrico monolithic construction eliminates numerous special shapes and does away with trouble-making joints.

100 LOCAL STOCKS—Warehouse stocks are carried in over 100 cities in U. S. and Canada. Complete installation and construction service is provided, or your own maintenance men can install Plibrico. Your local distributor will give you facts about Plibrico products and service. Or write for our big catalog which tells the dollar-saving Plibrico story.

PLIBRICO JOINTLESS FIREBRICK CO.

Nation-Wide Boiler Setting Service

1803 KINGSBURY ST., (DEPT. C), CHICAGO, ILL.

Board of Governors Directs Lion Recreation Club

MARIAN LISMAN
Lion Oil Refining Company

THE Employe Recreation Club of Lion Oil Refining Company was organized in 1934 under management sponsorship to promote the mutual betterment of all employes along the lines of sociability and good fellowship. Club activities for a long time were carried on in a downtown building in El Dorado rented for this purpose. The building was old and its facilities far from adequate.

The management, satisfied that the widespread employe interest and participation in the club was worth a capital investment, decided to erect a recreation club house on its own property. This was done in 1941, and in mid-September of that year the club was opened.

The building is located on property adjoining the refinery grounds in El Dorado and one wing is included in the refinery area, this section containing an office, lockers and showers under refinery management. A first-aid room is also included in the building for refinery workers and is among the most completely equipped within this section of the nation for administering to ordinary injuries.

Operation of the recreation club is directed by Charles C. Thompson, who succeeded his son Charles C. Thompson, Jr., a trained recreational supervisor, who was first manager of the club. The junior Thompson is now a lieutenant in the Army Signal Corps.

Club hours are from 11 a.m. to 9 p.m. daily, except Sunday. Operations are under the supervision of the Employes' Board of Governors which is composed of 10 members representing all company divisions. There is a porter who attends to the general service work required at the club.

The new club building is a gathering spot for employes and a location for dances and other social affairs within the organization of Lion Oil Refining Company.

The average employe thinks of his recreation club as "a good place to have a lot of fun free." If he likes games, he enjoys participating in the activities offered by the assembly room. If he likes quiet relaxation, he looks forward to pleasant moments of browsing in the reading room. If he likes to talk, he can always find a "buddy" to engage over a cup of coffee in the club restaurant.

Between shifts the game room finds its facilities in constant use.

Reflecting the Spanish influence in its red tile roof, the club building is a one story, buff-colored brick veneer structure. It is modern in every respect and completely equipped as to fixtures and furnishings. It is provided throughout with fluorescent lighting, with gas-fired unit heaters for winter and a circulating fan system for summer.

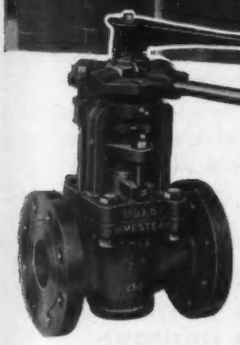
Since the construction of the club, major expenses entailed have been for salaries of manager and porter and for replenishments. There is no rent to pay, of course, and utilities are at a minimum, being obtained on refinery rates.

Center of activity at the club is the commodious assembly hall. Its floor dimensions of 50x60 feet represent the largest enclosed floor space in El Dorado. This makes a spacious ballroom for company purposes, and the floors of first-grade maple wainscotted with pressed wood are especially suitable for dancing. The walls of the room are of celotex rible blend plank.

A folding partition of 20 doors can readily bisect the room and convert one half of it into a hall for safety and other meetings. This sliding-door arrangement is particularly advantageous at present when five temporary offices occupy one half the room, accommodating personnel of an emergency building program being conducted in the near vicinity by the Lion organization.

Pool, ping pong and domino tables are

Don't get caught with your *plants down!*



Here's *plain talk* about the so-called valve shortage.

From the start let's face the fact that valves are *hard to get.* But *you* have to get them . . . and *we're* working the clock around to see that you do.*

On time? When you want them? That's a different story . . . *and the happy ending is up to you!*

Positively there is *no valve shortage* . . . only a shortage of *time* to fill everyone's requirements *at once.* Ask us to fill immediately an order for ten or a thousand special specification valves, on the highest possible priority (not a directive), and we'd have to say "sorry." Give us the same order for valves you know NOW will be needed some months hence and we may even "beat the promise."

The answer to the "valve shortage" problem is this simple: *your* purchasing practices may need to be revised as much as *our* production procedure has been! The decades-old habit of ordering valves, pipe and fittings *last* must be *reversed.*

Until the valves are in the line the plant stays "down." Order at the blueprint or construction stage... not when the roof's on!

*(*Production increased nearly 800% in 12 months*).*

Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

Reference Book No. 38 shows standard types, sizes, and uses of Homestead Valves. Write for your free copy now.

HOMESTEAD VALVE MFG. CO.

P. O. BOX 87 . . . . . CORAOPOLIS, PENNSYLVANIA

installed in the assembly room except when the space is needed for other recreational purposes. There are four pool tables, four ping pong tables and eight domino tables, all of which see constant use and all of which are kept in A-1 condition.

The Barton Clubs, social organizations of which there is one for each company division, have access to the recreation building for bingo parties, dances and other group activities. Club facilities are always as available to women employes as to men and also to the feminine members of an employe's family.

A recent general office party held in the assembly hall was an outstanding success. An orchestra furnished music for dancing. Guests were registered and wore name cards to facilitate introductions. As a climax to the evening's festivities, a drawing was conducted by the master of ceremonies and the holder of the lucky number received a $25 war bond.

One of the most popular features of the recreation club is the reading room which is a branch of the El Dorado public library. About 300 books and a large variety of current periodicals are kept at this branch. Most of the books are along recreational lines . . . fiction, Western and detective stories, adventure and light romance. There are also a number of biographies and travel books and a shelf of children's books suitable for various ages. Thompson, who is in charge, will order any technical volumes desired from the city library.

A restaurant (privately operated) opening onto the main entrance hall just above the assembly room offers excellent service for those habitueés of the club wishing food or refreshment. Walls and ceilings of both restaurant and reading room are styled in keeping with those of the assembly room. Floors are of asphalt tile.

Below the restaurant and opening onto the entrance hall is an elaborate ladies' lounge. It is panelled with full length mirrors flanked by small makeup mirrors with shelves. A leather-upholstered corner seat and glass top makeup tables are built into the walls. Washroom facilities are surrounded by a glass block partition. The lounge has wainscotting of structural glass with black base and green body; balance of walls and ceilings are plastered and painted in a harmonizing rose.

The men's lounge has been finished with ivory and black structural wainscotting with plaster walls and ceiling.

Fullest possible use of the recreation club is encouraged by its board of governors. The board is composed of members who are elected by employes from their own ranks. Membership is apportioned among the six company divisions of general office, refinery, marketing, general service, pipe line and production. Five members of the board are elected each year. Alternate elections assure that there will always be five seasoned members to sit with the five, incoming members. The board hears the report of the club manager, considers suggestions brought to its attention and represents the employes for management.

Realizing that recreation is one of the best ways to further acquaintances and friendships and to keep morale at a high level, the board of governors believes that the recreation club has functions of particular importance to sustain in these difficult days of war.

"The life and soul of science is its practical application."
— *Lord Kelvin*

1778 — 1829
Sir Humphry Davy is probably best known for his inquiry into the nature of explosive gases and of flame, which led to the construction of his miner's safety lamp.

Davy also was a coworker with other physicists in the experiments which led to the incontrovertible theory that mechanical energy and heat were reciprocally convertible.

Pioneering in scientific discoveries has always enlarged the boundaries of knowledge, and engineering has applied that knowledge to useful ends. Alcorn pioneered in the engineering application of more than a century's accumulated knowledge of heat to the varying, ever new requirements of the processing of petroleum. For 19 years Alcorn has successfully designed and built dependable heaters for economical production of every type and grade of petroleum products.

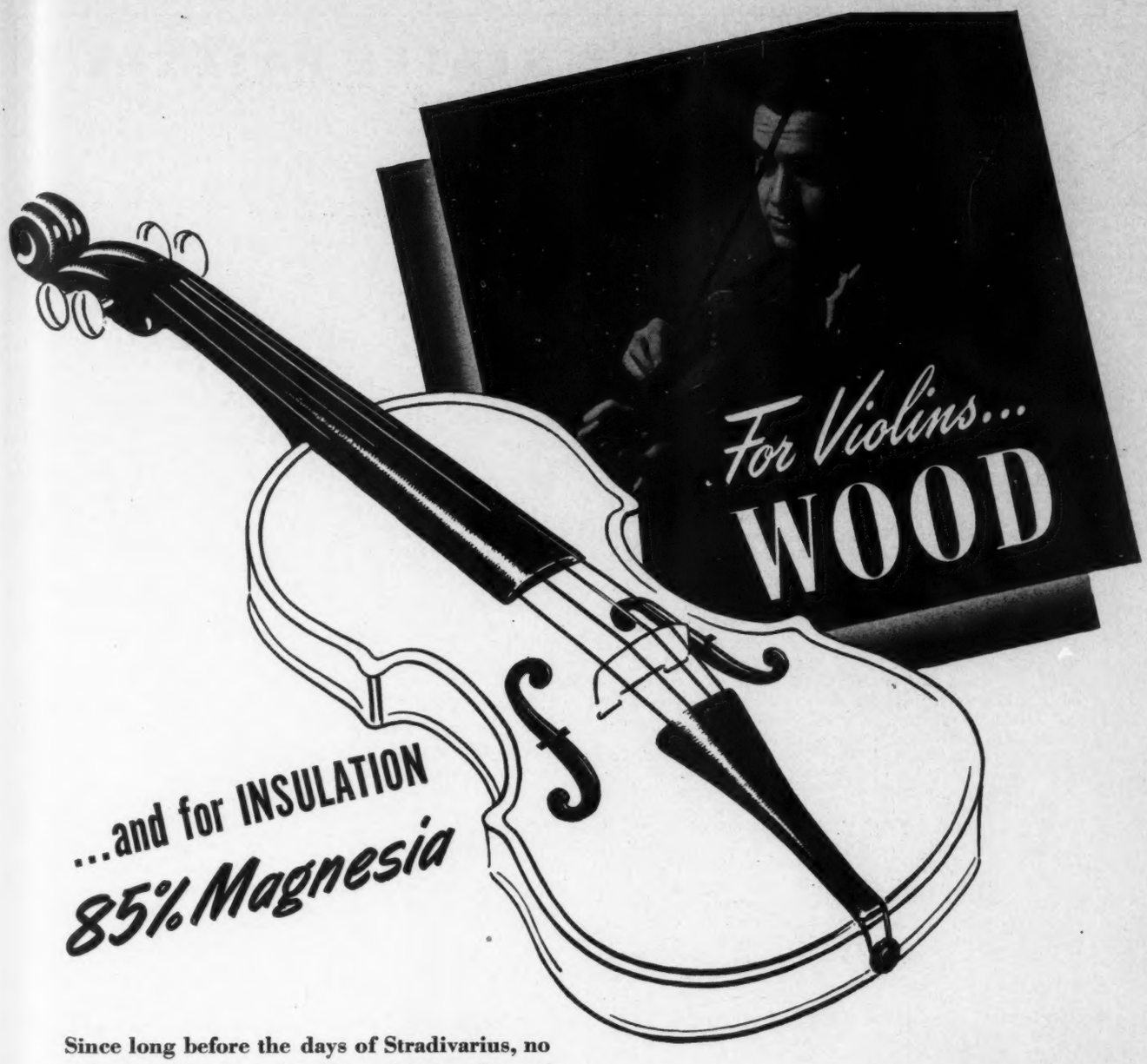
ALCORN
Combustion Company
SCHAFF BUILDING, PHILADELPHIA
Los Angeles • Houston • San Francisco

Plan Plant to Improve Gasoline Performance

Approval for construction of a large unit employing cycloversion, the newly announced catalytic process for the production of aviation gasoline, has been granted Phillips Petroleum Company, by PAW.

This announcement was made by Frank Phillips, chairman of the company. "This new cycloversion unit," said Phillips, "will convert automobile gasolines or other petroleum distillates into products which when blended with other components, will impart greatly improved flight performance to finished aviation fuels."

Capacity and location of the new catalytic cracking unit were not announced, but it was understood that the plant will be a substantial addition to the nation's aviation gasoline program.



Since long before the days of Stradivarius, no substitute has been found to take the place of wood in a violin. Time has proved it the *one* material for the purpose.

And in the field of industrial heat insulations, 85% Magnesia is the *one* material that has proved its ability to maintain efficiency . . . decade after decade. Records of more than half a century confirm this statement.

It will pay you to continue to specify and use Ehret's 85% Magnesia.

EHRET'S 85% MAGNESIA and many other Ehret heat insulating materials are fully treated, both as to selection and application, in the new 176-page Heat Insulation Handbook. It will be furnished, without obligation, to those interested in getting the most from their thermal insulations. Write today for your copy.

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...THERE IS AN *EHRET* DISTRIBUTOR OR CONTRACTOR IN EVERY INDUSTRIAL AREA

DIGEST OF UNITED STATES PATENTS

Recent Patents on Lubricants

Compiled by
HEINZ HEINEMANN, The Attapulgus Clay Co., Philadelphia

U.S.P. 2,289,748. Grease Composition for Lubrication. A. Beerbower and A. J. Morway to Standard Oil Development Company.

The composition consists of 5 to 50 percent of a metallic soap in mineral lubricating oil to which a small amount of guaiacol is added as an oxidation inhibitor. The metal soap causes the oil to gel. Metals of the first and second group of the periodic table and particularly sodium are preferred. According to the purpose the soap may contain either a slight excess of free alkali or of free acid.

U.S.P. 2,289,509. Lubricant. W. M. Malisoff to The Atlantic Refining Company.

The lubricant consists of a viscous hydrocarbon oil and a halogenated ester of a phosphorus acid, such as chlorinated tri-crescyl phosphate which is preferably used in a quantity of less than 10 percent. The aryl phosphate serves as a film-forming agent to increase the load-bearing ability and to decrease the wear between relatively moving metallic surfaces and may be used at extreme pressures of at least 10,000 pounds per square inch.

U.S.P. 2,289,795. Lubricant. J. G. McNab to Standard Oil Development Company.

The lubricating composition consists of a mineral lubricating oil and small amounts of salts of polyvalent metals of the groups consisting of aluminum, nickel, and alkaline earths, salts of at least two of these groups being present. The total amounts of the metal salts shall be from 1. to 3.5 percent by weight of the oil and the amount of each type of metal salt at least one tenth of the total metal salt present. The various metal salts used have the general formula $M(XY)_n$, in which M is the metal, X oxygen sulphur, selenium or tellurium and Y an organic radical. The subscript n represents a numeral corresponding to the valence of the metal used. The organic radical may be alkyl, aryl, alkylated aryl, carbamyl, xanthyl, thioxanthyl, enolyl, acyl and thioacyl, phosphyl or thio phosphyl. This radical is to be chosen so that the polyvalent metal salt is soluble in the used mineral oil. For instance, a mixture of a nickel alkyl phonolate sulfide and barium alkyl phenolate sulfide may be employed. For diesel engines in particular the mineral oil shall have a viscosity of 40 to 75 seconds Saybolt at 210° F. and a pour point at least as low as 30° F. The function of the added soaps is mainly one of maintaining a clean engine condition.

U.S.P. 2,290,032. Extreme-Pressure Lubricant. R. E. Burk to Standard Oil Company of Ohio.

For improving the extreme pressure properties of a lubricating oil an iron oxide or sulfide is colloidally dispersed in the oil in a relatively small quantity, preferably amounting to from .5 to 2.0 percent of the oil. The iron oxide used may be obtained by the decomposition of iron carbonyl. The colloids have substantially spherical shape as dispersed particles, thus attaining a remarkable lubricity. Small amounts of an inhibitor such as a phosphate or phosphite ester or a condensation product of an aromatic aldehyde with diamine may be added in amounts of e.g. 0.0005 percent.

U.S.P. 2,290,316. Lubricant. E. W. Cook to Tide Water Associated Oil Company.

In order to prevent corrosion of bearing metals, such as cadmium-silver, cadmium-nickel and cadmium-lead alloys by mineral lubricating oils, a minor proportion of a sulfurized aldehyde amine compound is added to said oil, preferably a compound like sulfurized hept aldehyde - aniline and sulfurized heptaldehyde-alpha-naphthylamine. Such compounds are obtained by the reaction of a polysulfide or other sulfur compounds on an aldehyde amine.

U.S.P. 2,290,859. Beneficiation of Lubricants. R. E. Burk and E. C. Hughes to Standard Oil Company of Ohio.

To increase the stability of mineral lubricating oils against high temperatures a small amount of phosphorus preferably ordinary yellow phosphorus and a small amount of an organic phosphate or phosphite is added, the latter to inhibit metal corrosion by the phosphorus. The used inhibitors have the formula: $\begin{matrix} R-X \\ Z-X-M \\ Z-X \end{matrix}$ wherein R is an alkyl, aryl, alkyryl or cycloparaffin hydrocarbon, Z is hydrogen or alkyl or aryl hydrocarbons or mixtures thereof, X is oxygen or sulphur and M is phosphorus or phosphorus monoxide. Tricresyl phosphite and phosphate and tricresyl thiophosphate are suggested.

U.S.P. 2,290,860. Beneficiation of Lubricating Oils. R. E. Burk and E. C. Hughes to Standard Oil Company of Ohio.

Instead of the inhibitors named in U.S.P. 2,290,859 a small addition of a methane-base derivative is made, such as a derivative of diamino diphenyl methane, tetramethyl diamino diphenyl methane, etc.

U.S.P. 2,290,872. Stabilized Liquid Hydrocarbon. D. R. Freyl to The Lubri-Zol Corporation.

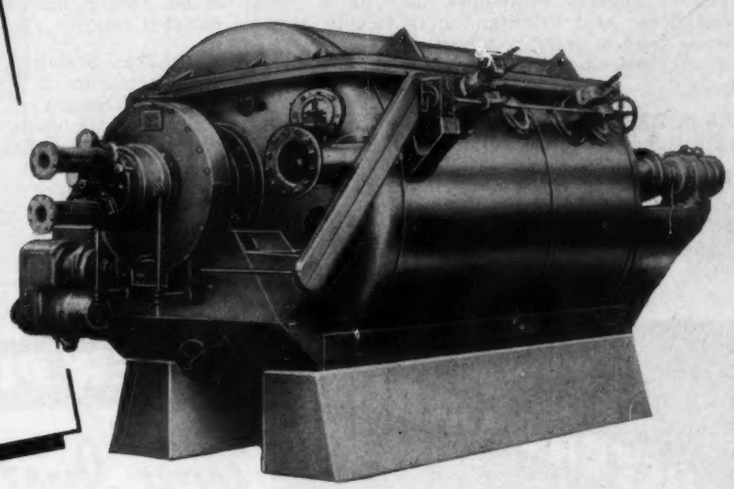
To prevent the detoriation by oxydation or polymerization of liquid hydrocarbon compositions such as lubricating oils, a small amount (preferably less than 1 percent) of an oil-soluble compound is added which consists of the reaction products of PCl_3 with cyclohexanol or its homologues or mixtures thereof or halogen-bearing derivatives of any of these reaction products or salts or ester-salts of them. For instance tricyclo hexyl phosphite may be used.

U.S.P. 2,291,066. Lubricant. S. P. Waugh to Tide Water Associated Oil Company.

A lubricating composition to be used in metal-working operations comprises a stable aqueous emulsion containing mineral oil, a saponified component like

A LEADING OIL COMPANY

buys its 4th
OLIVER
Pressure Precoat
FILTER



1 . . . to protect its high-octane gasoline program
2 . . . to protect its synthetic rubber program

This refinery has a double-barreled program, varying its production according to war requirements of both high-octane gasoline and butadiene. The three Oliver Pressure Precoat Filters in use are up to their capacity.

Having had three Oliver Pressure Precoat Filters giving satisfactory service for several years, it is adding a fourth unit for the emergency program.

The Oliver *Pressure* Precoat Filter in this refinery has proved its worth in several ways. It handles a difficult filtration job very satisfactorily. It operates continuously. It operates under pressure. Its operating and maintenance costs are low.

Continuous pressure filtration is now practicable for certain operations heretofore confined to batch filtration.

We'll be glad to discuss its application to your problems. Perhaps Oliver Continuous Pressure Filtration will provide the satisfactory answer.

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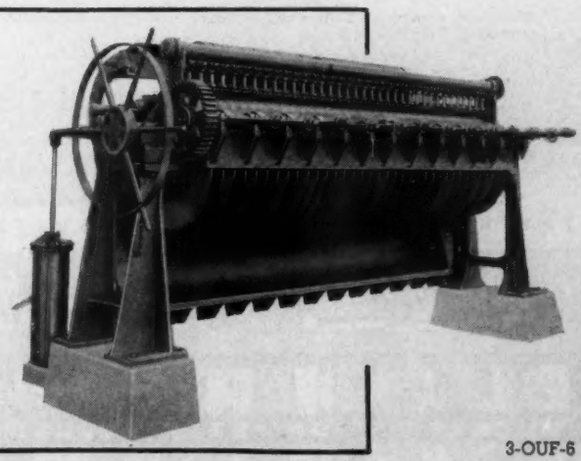
Factories: Oakland, Calif.; Hazleton, Pa., and Orillia, Ont., Can.

8 Large Sweetland Pressure Filters have also been ordered for 2 extensive new refinery projects



3-OUF-6

saponified palm oil or a triethanolamine soap of palm-oil fatty acids and a phosphorus containing substance for increasing the load-carrying capacity of the composition. This phosphorus compound may for instance be the reaction product of a phosphorus acid and a hydroxy organic compound such as a phosphoric acid ester and may be obtained by reacting phosphoric acid and an alkylolamine such as triethanolamine.

U.S.P. 2,291,166. Lubricant. O. L. Maag to Lubri-Zol Development Corporation.

The extreme pressure properties and corrosion stability of a lubricating oil are improved by an addition of up to 10 percent of a fluorinated or brominated member of the paraffin series heavier than methane. The fluorinated products are the most effective ones. Compounds having a vapor pressure less than atmospheric at 185° C. or at 140° C. are preferred. Examples of the added compounds are hexa fluor ethane, the fluorinated products of propane, butane hexane, decane, fluorinated mineral oil or paraffin wax.

U.S.P. 2,291,214. Stabilization of Oils. M. A. Dietrich to E. I. duPont de Nemours & Company.

To a viscous hydrocarbon petroleum oil normally tending to deteriorate in the presence of oxygen is given an undissolved oil-insoluble, water-insoluble dilute aklali-insoluble film-forming basic amine resin in sufficient amount and for sufficient length of time to materially inhibit reaction with oxygen.

INSTEAD OF BUYING A NEW PUMP
You Install
A
NEW
LINER
WHEN YOU HAVE
A BLACKMER ROTARY
20 years of service is not unusual.
BLACKMER
CONSERVE CRITICAL MATERIALS
PUT THIS PUMP ECONOMY TO WORK IN YOUR PLANT NOW
Prompt Delivery on Pumps for Refineries in War Production
Blackmer pumps with removable liners have solved many a tough pumping problem handling "difficult" liquids.
• They reduce maintenance cost—you replace a liner instead of junking the pump.
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Standard units with removable liners are furnished in capacities from 20 to 750 GPM; pressures to 300 psi.
Bulletins FREE to pump users.
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Write Blackmer Pump Company, 2093 Century Avenue, Grand Rapids, Michigan
SERVING THE PETROLEUM INDUSTRY FOR 40 YEARS
BLACKMER Rotary PUMPS
"BUCKET DESIGN"—SELF-ADJUSTING FOR WEAR

U.S.P. 2,291,404. Lubricant. A. J. Morway to Jasco, Inc.

The lubricant consists of a lubricating oil and a sulfurized isobutylene polymer of high molecular weight (above about 1000). The sulfurized isobutylene may derive from the low-temperature polymerization of an iso mono olefin and is added in amounts sufficient to impart extreme-pressure properties to lubricating oil. The sulfurization of the polymerized iso butylene polymer is effective by sulphur chloride. The sulfurized iso butylene polymer is of resinous character if its molecular weight is sufficiently high.

U.S.P. 2,292,308. Lubricating Oil Composition. F. M. Watkins to Sinclair Refining Company.

The liquid lubricating-oil composition consists of a petroleum lubricating oil and a metal salt of an alkyl mono ester of an alkenyl substituted succinic acid. The metal salt may be either a Ca, Al, Ba, Cd, Cr, Mg, Ni, Sn or Zn salt. Laurenyl succinic acid is the preferred alkenyl substituted acid used. The new compositions have in addition to their lubricating properties a high solvent capacity for sludge as formed by the oxydation of the petroleum lubricating oils and also have the property of softening hard sludge and carbon deposits.

U.S.P. 2,292,456. Lubricating Oil. B. H. Lincoln and G. D. Byrkit to Continental Oil Company.

The lubricant consists of a hydrocarbon oil and a small quantity of trimethylene-1,2-disulfide. Preferably .05 to 2.0 by weight of the latter are used. The lubricant has a reduced tendency to oxydize and form sludge and soluble oxydation products and has increased film strength.

U.S.P. 2,292,672. Lubricant. R. A. Swenson to Standard Oil Company of Indiana.

A lubricant for machinery rolling necks in roll mills is described. It is semi-fluid at room temperature but sufficiently viscous to stand extreme service conditions. A petroleum oil (25 to 55 percent) is mixed with blown asphalt (30 to 50 percent) preferably having a softening point of 175-185° F. and 2 to 20 percent of high lead fish oil soap. The lubricant has a Saybolt Universal viscosity at 210° of 220 to 450 seconds.

U.S.P. 2,293,237. Hydrocarbon Product. J. H. Bartlett to Standard Oil Development Company.

Mineral lubricants are improved by adding antioxidants. A new class of antioxidants is described comprising the perinaphtho-thiazines and their derivatives, 0.01 to 1.0 percent are effective, 0.1 percent preferred.

U.S.P. 2,293,445. Lubricant With High Temperature Stability. J. F. Nelson to Standard Oil Development Company.

One-fourth percent of tritertiary butyl ortho hydroxy phenyl phosphate is added to a highly refined mineral oil as an antioxidant.

U.S.P. 2,294,525. Inhibitor. St. P. Waugh to Tide Water Associated Oil Company.

The invention relates to a lubricant of high load-carrying properties. For this purpose the lubricant is composed of a mineral lubricating oil and a substance effective to impart high load-carrying properties which however normally

LUBE OIL PRODUCTION INCREASED 60%

AND NO NEW EQUIPMENT REQUIRED

A Mid-Continent refinery was swamped with rush orders for high quality specification lube oil. These specifications slowed down plant production to less than normal, and even so, barely met quality. The situation called for quick action to meet war-time demands.

A Filtrol service engineer studied the problem. Changes were made in the acid treating procedure and contacting technique and the use of Super Filtrol was instituted. The result: improved quality of the oil to specification *plus* and stepped up production to 160% of the normal plant capacity. The economy effected amounted to more than the total cost of the clay originally used, and the rush orders were filled.

This is but one of the many production-increasing jobs Super Filtrol is doing to get more and better oil —oil that is the ammunition needed to help America win this war. Why not let Filtrol Service help you?

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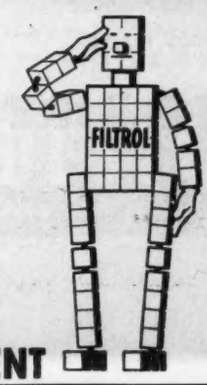
Plants: Vernon, California Jackson, Mississippi



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causes corrosion of metal surfaces, such as a chlorine-containing substance. To prevent such corrosion a minor proportion of a substance is added which is prepared by reacting a chromate with an amine and then reacting the resulting compound with an organic acid.

U.S.P. 2,293,052. Lubricant Containing a Lithium Compound. C. E. Earle.

Lubricating greases are thickened and made water resistant by adding lithium and calcium soaps not in excess of 40 percent to the oil.

U.S.P. 2,294,526. Stabilized Mineral Oil Composition. St. P. Waugh to Tide Water Associated Oil Company.

The invention relates to a lubricant composition to be used in first line for lubricating internal-combustion engines. It consists of a hydrocarbon oil in which a neutral metal soap of a character not normally soluble in said oil and a salt of an ester of a sulfo carboxylic acid for solubilizing said soap are dissolved. A neutral alkaline-earth-metal naphthenate may be used as the soap and the sodium salt of the dioctyl ester of sulfosuccinic acid as the solubilizing compound. The soap constituent of the composition prevents a deterioration of the lubricant during use.

U.S.P. 2,294,804. Extreme-Pressure Lubricant. V. N. Ricketts to E. I. du Pont de Nemours & Company.

In order to permit moving metal surfaces to be loaded to greater pressure than ordinary lubricants would permit, a minor proportion of an aliphatic ester of phosphorous acid is added in which each aliphatic group contains from 1 to 5 C atoms. The aliphatic radicals can be alkyl, halogen substituted, amino-substituted, hydroxy substituted alkyl radicals.

U.S.P. 2,294,817. Extreme Pressure Lubricant. W. J. Dominicus van Dijk to E. I. du Pont de Nemours & Company.

As additives to make a mineral lubricant stand up under extreme pressure conditions, a minor proportion of a mixture of castor oil and P_2O_5 is recommended. Instead of this mixture a minor proportion of a member of the group consisting of reaction products of fatty oils and oxides of phosphorus, organic esters of the acids of arsenic, selenium, tellurium, oxides, sulfides and selenides of phosphorus and arsenic, oxides and sulfides of selenium and oxides of tellurium may be used.

U.S.P. 2,295,053. Hydrocarbon Oils Containing Organic Trisulphides as Oxydation Inhibitors. R. Rosen and R. M. Thomas to Standard Oil Development Company.

To a well refined hydrocarbon lubricating oil is added less than 2 percent of an organic trisulfide to prevent oxydation.

U.S.P. 2,295,179. Lubricating Composition and Modified Addition Agent Therefor. C. M. Loane to Standard Oil Company (Indiana).

Phosphatides to be used as addition agents for lubricating oils, especially such for use in automotive engines, are neutralized by a basic substance at temperatures below about 300° F. to improve their effectiveness. Preferably an organic amine such as an alkylol amine or aromatic amine is used for this purpose. As the phosphatidic material lecithin or cephalin may be used.

U.S.P. 2,295,192. Lubricating Composition and Modified Agents for the Same. M. H. Arreson to Standard Oil Company (Indiana).

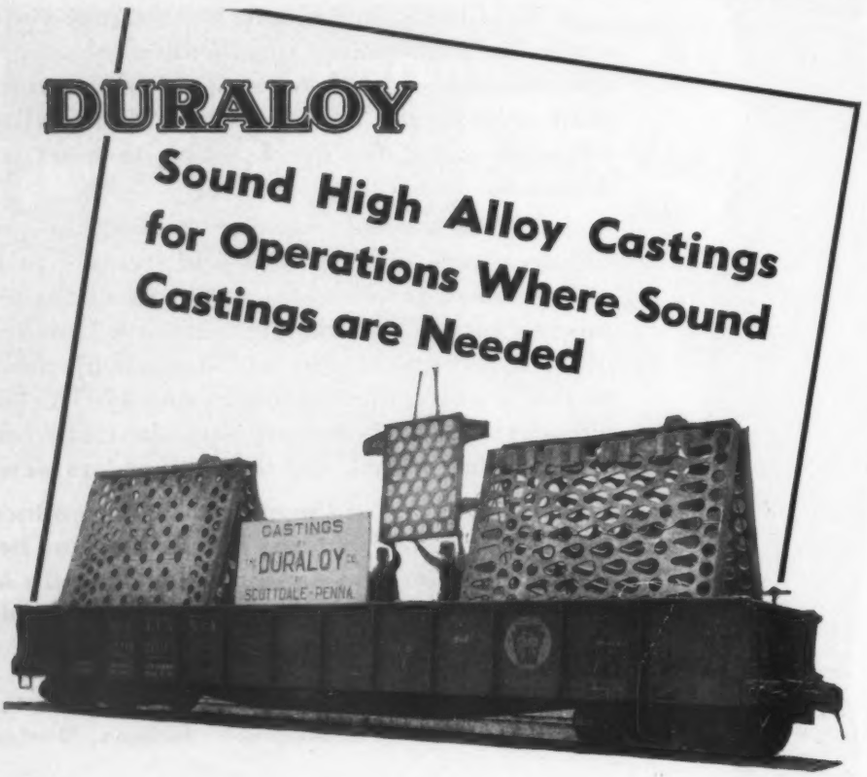
The invention relates to the use of phosphatidic material as an addition agent for lubricants and an organic amine for neutralizing this addition agent. In this case hydrogenated phosphatides are used for the purpose and subjected to the treatment described in patent 2,295,179.

U.S.P. 2,296,315. Lubricating Composition. W. J. Sparks and D. C. Field to Standard Oil Development Company.

Resinous and gummy compositions are described which are readily soluble in hydrocarbon oils and when dissolved in lubricating oil increase its viscosity and improve the visc-index. China-wood oil or oiticina oils or any glyceride having a system of conjugated double bonds may be copolymerized with olefins or diolefins in the presence of a metal halide such as BF_3 or $AlCl_3$ to form such deposits.

U.S.P. 2,296,342. Stable Breaking-In Oil. P. J. Gaylor and E. L. Baldeschwieler to Standard Oil Development Company.

Oil compositions which do not corrode the metal parts they are lubricating are claimed. In a mineral lubricating oil a small quantity of an amine soluble in said oil and from about 0.01 to 5 percent of an oil-soluble ester of an acid



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Dealing with the problems in heat insulation faced by refinery engineers and solved by using UNARCO unibestos

1a THE PROBLEM

Removing insulation for periodic inspection of hot oil lines presents a problem. It can be costly and time-consuming unless material is applied that lends itself to frequent handling. Frequent inspections lower the efficiency of ordinary insulations and very often necessitate replacement.

1b THE SOLUTION

It is suggested that a combination of Super and Standard Unibestos in single layer construction be applied. This will permit easy removal from the pipe and the insulation can then be set aside during the test. After the test Unibestos can be reapplied without any loss of efficiency. In addition, considerable time will be saved through use of Unibestos, the sectional insulation, in single layer construction.

unibestos is available in Standard material, for temperatures up to 750°; Super, with a temperature limit of 1200°; Combination, with a temperature limit of 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes. Unibestos is available in half sections up to 30" pipe diameter and from 32" to 60" in quadrants from ¾" to 5" in thickness. Standard and Super Unibestos are both available in single layer construction with provision for expansion in piping, where it is required.

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which forms oil-insoluble salts with the metal in contact therewith.

U.S.P. 2,298,080. Lubricating Oil for Diesel Engines. P. S. Clarke and M. T. Flaxman to Union Oil Company of California.

A lubricating oil for internal-combustion engines is described comprising high viscosity-index mineral lubricating oils containing a minor proportion (0.5 to 1.5 percent) of oil-soluble alkaline-earth-metal soaps of phosphonic acids prepared by phosphorizing and oxidixing paraffinic mineral lubricating oils and a minor proportion of lower aliphatic alcohol esters of synthetic acids from the oxydation of highly paraffinic mineral-oil fractions.

U.S.P. 2,298,301. Lubricant and Method of Lubricating. A. T. Knutson to Lubri-Zol Corporation.

A lubricating composition is claimed which comprises a lubricating mineral oil and from 0.1 to about 20 percent, based on the amount of mineral oil, of a halogenated hydro-aromatic ketone having a vapor pressure less than atmospheric at 140° C.

U.S.P. 2,298,317. Manufacture of Lubricating Greases. H. G. Smith to Gulf Oil Corporation.

In order to remove gases and vapors from greases, a grease mixture including a lubricating oil and a soap is agitated in a kettle under sufficient vacuum to prevent trapping and occluding of gases.

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There is a Wilson Tube Cleaner, cutter head or other accessory especially suitable for *quickly, thoroughly* and *economically* removing any coke, gum or scale encountered in any refinery tubes or pipes.

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U.S.P. 2,298,636 to 640. Lubricating Composition. C. F. Prutton to Lubri-Zol Corporation.

An extreme-pressure lubricating composition is described which comprises a major proportion of a refined mineral lubricating oil, the load-carrying ability of which is substantially increased by the inclusion therein of a minor amount of a stable, oil-soluble extreme-pressure addition agent, having a vapor pressure less than atmospheric at 140° C., the effectiveness of which is dependent upon its ability to chemically react with the metallic surfaces to be lubricated. The composition also includes a minor amount of an oil-soluble organic corrosion inhibitor which does not substantially decrease the extreme-pressure properties.

U.S.P. 2,298,833. Lubricant. C. W. Muessig to Jasco, Inc.

A lubricating composition is prepared by blending a lubricating oil with a minor proportion of a halogenated high-molecular-weight polymer of a n-olefin containing 2 to 3 C atoms per molecule in a viscosity-improving amount.

U.S.P. 2,298,855. Lubricant. D. L. Wright to Jasco, Inc.

A steam-cylinder lubricant is prepared by combining a steam-reduced cylinder oil (at least 100 Saybolt seconds at 210° F.) with a minute quantity of polyisobutylene dissolved in the oil together with 3 to 20 percent of auxiliary fatty material.

U.S.P. 2,302,429. Art of Dewaxing Lubricating Oils. E. M. Dons and O. G. Mauro to Mid-Continent Petroleum Corporation.

Petroleum oils and wax are separated by dissolving them in a solvent comprising more than 25 percent isopropyl acetate and less than 75 percent methylene dichloride, cooling the solution to a temperature at which the solvent components will selectively dissolve the oil and reject the wax. The oil is then separated.

U.S.P. 2,303,068. Lubricant and Preparation Thereof. G. H. Schoenbaum to Jasco, Inc.

Fifty to 90 percent mineral oil having a viscosity of about 200 to 250 Saybolt seconds at 210° F. and a flash point of at least 600° F. are composited with 1 to 25 percent of a finely-divided fibrous solid and about 5 to 40 percent of petrolatum having a melting point not lower than about 110° F. The amount of petrolatum must be sufficient to prevent separation of the fibrous solid during storage.

U.S.P. 2,302,703. Organic Phosphorus Compound Bearing Lubricant. B. H. Lincoln and G. D. Byrkit to Continental Oil Company.

A lubricant is described comprising in combination a major proportion of oil of lubricating viscosity and a minor proportion of an organic phosphorus compound containing at least one nitrogen-phosphorus double bond.

U.S.P. 2,303,721. Art of Dewaxing Oils. D. G. Brandt to Cities Service Oil Company.

A process of separating wax or petrolatum from mineral-oil lubricants is claimed which comprises mixing the mineral oil to be dewaxed with a low-boiling-point hydrocarbon at a temperature of approximately 100° F., slowly

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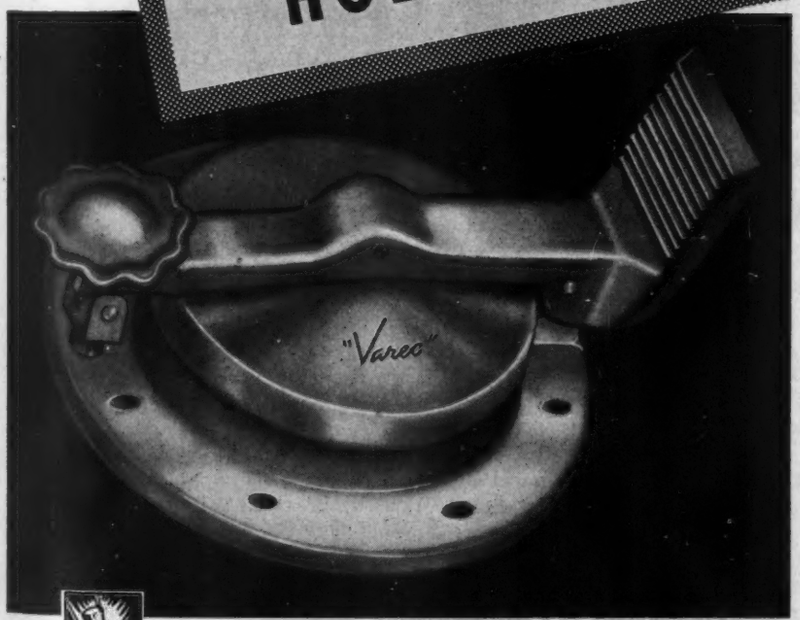

FIG. NO. 42S PRESSURE TYPE FLANGE BASE

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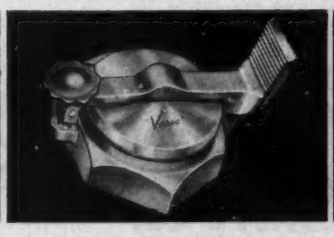


Fig. No. 48S
PRESSURE TYPE SCREWED BASE

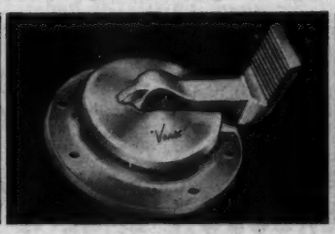


Fig. No. 40S
FLANGED BASE

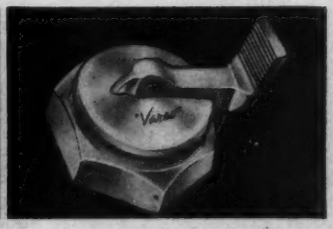


Fig. No. 46S
SCREWED BASE

cooling the resulting mixture to a temperature of from 25 to 40° F. and then rapidly chilling the mixture to a temperature of about —40° F. by vaporizing a portion of the low-boiling-point hydrocarbon contained in the mixture, maintaining a predetermined proportion of low-boiling hydrocarbon in the mixture during said chilling by adding necessary quantities of cold liquid low-boiling hydrocarbons thereto and separating the precipitated wax from the chilled mixture.

U.S.P. 2,304,874. Lubricant. E. R. Barnard to Standard Oil Company (Indiana).

A lubricating mixture is claimed, comprising a narrow-cut solvent-extracted petroleum oil having a 90 percent distillation point under 1mm Hg not substantially greater than about 200° F. above the initial boiling point at 1mm Hg and from about 1 to about 40 percent of an isobutylene polymer having a Saybolt viscosity at 210° F. of about 185 seconds to about 500 section and a flash point of about 350 to 450° F.

U.S.P. 2,305,560. Steam Cylinder Oil. K. F. Schiermeyer to Shell Development Company.

Claim: A steam clyinder lubricating oil consisting essentially of a mineral lubricating oil free from asphaltenes and of viscosity suitable for steam-cylinder oil containing a minor proportion of an alkali-metal salt of an organic detergent-forming acid and from about 1 percent to about 15 percent by weight of added petroleum resins.

U.S.P. 3,305,627. Lubricating Oil. B. H. Lincoln and G. D. Byrkit to Lubri-Zol Development Corporation.

A major proportion of an oil of lubricating viscosity and a minor proportion of a tin and halogen bearing reaction product of a stannic halide and a β-diketone are mixed.

U.S.P. 2,306,017. Pour-Point Depressant for Lubricating Oils. J. Faust to L. Sonneborn Sons, Inc.

A lubricating-oil composition of relatively low, substantially non-fugitive, non-reverting pour point, comprising a wax containing petroleum hydrocarbon oil having normally a relatively high pour point due to the wax contained therein and 0.1 to 0.75 percent of a stannous stearate obtained by fusing together freshly precipitated stannous hydroxide with stearic acid in an inert atmosphere, said stannous stearate being substantially soluble in said hydrocarbon oil to form substantially clear solution therein, is claimed.

U.S.P. 2,306,971. Improving Lubricating Oils. E. B. McConnell and J. M. Musselman to Standard Oil Company of Ohio.

A process of preparing lubricating oils which comprises heating molar proportions of triamylamine and sulphur to reaction and incorporating a small amount of the reaction product in a mineral oil of lubricating viscosity.

Aluminum Chloride Put Under Preference Order

Through general preference order N-287, the Director General for Operations in February took action to assure proper flow of anhydrous aluminum chloride to plants which require the product for military products. The order became effective March 15.

Purpose of the order is to conserve aluminum and chlorine and to insure the smooth flow of materials from east of the Mississippi River, where estimated production is in excess of requirements, to other areas of the nation where the surplus is needed. The order provides that on and after March 15, 1943, no one may deliver or use anhydrous aluminum chloride except as specifically authorized or directed by the Director General.

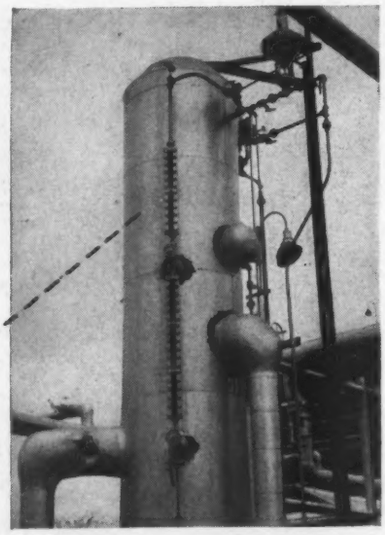
Exception from authorization is made for delivery or use of not more than 50 pounds in any month under conditions set forth in the order. No certificate is required for delivery of not more than 10 pounds in any month.

Anyone seeking authorization to accept or deliver anhydrous aluminum chloride in any month beginning with April, 1943, is required to file application on or before the 15th of the preceding month. Where delivery or use is to be in March, application should be filed as many days as possible in advance of the requested acceptance of delivery or use.

Gary Before Western Petroleum Refiners

Wright W. Gary, president of Filtrol Corporation, Los Angeles, and formerly director of refining, Office of Petroleum Administration, discussed refinery catalysts and catalytic processes at a meeting of the Western Petroleum Refiners Association at Tulsa February 26.

The Eye Line is the Check Line



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Standard JERGUSON Reflex Gages are made for service conditions up to 3200 pounds (at 100° F.) or up to 1200 pounds (at 1000° F.).

Transparent Gages are made for service conditions up to 2000 pounds (at 100° F.) and up to 600 pounds (at 1000° F.).

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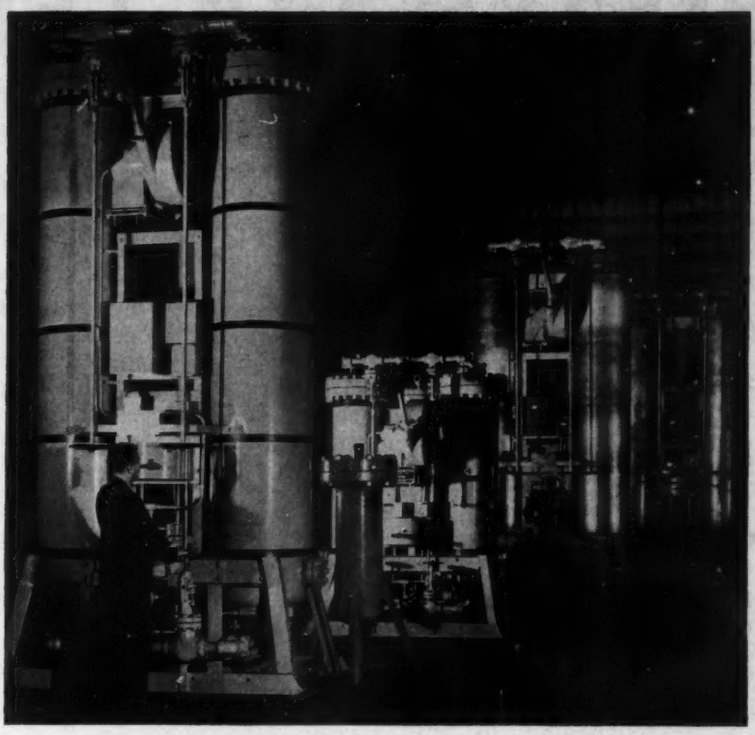

These Lectrodryers were photographed as they left for points best known to the censors. Like hundreds of others, they are now at work on synthetic rubber production, in oxygen plants, and on dozens of other processes vital to the war effort.

Lectrodryers are DRYING MACHINES. They control humidity. They dry air and gases to extremely low dew points, at either atmospheric pressure or compressed to 3,000 pounds per square inch. They dry many of the organic liquids so important today. Although engineered for every installation, each is a standard, proved design.

Lectrodryers are speeding war production. Work is now done in atmospheres of definite humidity, with gases and liquids of known dryness. Materials contain only the water that is wanted there. Because Lectrodryers use Activated Aluminas as their drying agent, you can dry liquids and gases DRY, to dew points below −110°F.

This experience with controlled humidity and dryness spells the doom of hit-or-miss methods of production. Postwar industry is going to demand the same independence of outside weather conditions, the same sureness of quality and speed of production. Lectrodryer engineers will gladly help shape your thinking on these problems.

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SCIENCE AND TECHNOLOGY

Abstracts prepared in co-operation with the

PETROLEUM REFINER

by

THE LESLIE LABORATORIES

Traver Road, Ann Arbor, Mich.

under the supervision of

DR. E. H. LESLIE and DR. H. B. COATS

The abstracts here presented are selected from the current literature of science and technology to afford reference to fundamental information not easily available to all readers. Abstracts of articles appearing in readily obtainable trade journals are not included.

Photostat copies of original articles will be supplied at cost by the Leslie Laboratories. Complete or limited bibliographies covering special topics by title, by abstracts, or in complete manuscript, will also be prepared and furnished at reasonable cost by the Laboratories.

Fundamental Physical And Chemical Data

The Heat Capacities at Higher Temperatures of Ethane and Propane, B. F. DAILEY WITH W. A. FELSING, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 42-4.

The heat capacities of air, ethane, and propane were determined over the temperature range 340-700° K. using a modified Bennewitz and Schulze type adiabatic flow calorimeter. In the method of Bennewitz and Schulze the heat capacity of the gas is obtained in terms of the electrical energy input of a heater that is necessary to maintain a linear temperature gradient along a thin-walled Pyrex tube, placed between two massive brass blocks maintained at a temperature difference, ΔT, through which a stream of the gas is flowing at a known velocity. The results are believed to be accurate to within at least one part in 100. In the case of ethane, the agreement between experimental and calculated values was good. This is also true in the case of propane. In the lower temperature range the data were in good agreement with those of Kistiakowsky and Rice, but in less satisfactory agreement with those of Sage, Webster and Lacey. The calorimeter used in the work was modified to increase the ease of manipulation and to improve the accuracy of heat capacity determinations at higher temperatures.

Heat Capacities of and Hindered Rotation in n-Butane and Isobutane, B. P. DAILEY WITH W. A. FELSING, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 44-6.

The gaseous heat capacities of n-butane and isobutane were measured over a temperature range of 340 to 700° K. and are presented in tabular and graphical form. The apparatus used was the same as that used by the authors in determining the heat capacities of ethane and propane. Pitzer has presented a general equation for the calculation of the gaseous heat capacities of hydrocarbon which is stated to be applicable at temperatures up to 450° K. The results of this investigation are in good agreement with this equation up to approximately 500° K. At higher temperatures the experimental heat capacities are less than predicted by Pitzer's general linear equation. The heat capacity of n-butane was found to be consistently slightly higher than the heat capacity of the isobutane at corresponding temperatures. The structure of the two butane molecules is discussed in the light of the experimental results.

The Heats of Vaporization of Some Hexanes, J. F. LEMONS WITH W. A. FELSING, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 46-8.

The investigation is one in a continuing program of determining reliable data on the thermodynamic properties of pure hydrocarbons. The densities of liquid n-hexane, 2-methylpentane and 2,3-dimethylbutane were determined over the temperature range 0° to their normal boiling points. The heats of vaporization of the three hexanes were determined over a temperature range of 20° C. to their normal boiling points. The calorimeter used was similar in design to the one proposed by Keyes and Beattie. The vaporization process was completely adiabatic. The vaporization was non-turbulent, thus assuring a dry vapor. The vaporization was a continuous process, ensuring a series of determinations that could be averaged under conditions that practically eliminated personal errors in reading. Finally, the mass of material vaporized and the energy input could be accurately determined. Previous work by other investigators was reviewed and compared with the experimental results. A consideration of all the possible sources of error points to a maximum over-all error of $\pm 1\%$. The greater the branching of the hydrocarbons, the smaller the heat of vaporization insofar as the hexanes studied are concerned.

The Viscosity-Temperature Function of Liquids, E. P. IRANY, *Phil. Mag.* **33** (1942) pp. 685-8.

A general relationship between the viscosity and the temperature of liquids was derived by Nissan, using a graphical method that involves a functional scale. The principle of this scale, as well as the deductions made by Nissan, had already been disclosed by Irany in 1938. The identity of the method of Nissan with that of Irany is proved. The author considers that Nissan's deductions transcend the origins of the formula used.

Premelting Anomalies of Some Long-Chain Normal Paraffin Hydrocarbons, A. VAN HOOK AND L. SILVER, *J. Chem. Phys.* **10** (1942) pp. 686-90.

The coefficients of thermal expansion of the long-chain paraffins $C_{14}H_{30}$, $C_{18}H_{34}$, $C_{18}H_{28}$ and $C_{24}H_{50}$ were measured over a wide temperature range on both sides of the melting points of the compounds. The fact that the coefficients increased near the melting points suggests an order-disorder mechanism for the transitions. Although the effect is larger on the solid side of the transition than on the liquid side, the latter is more significant, since the presence of impurities and the open, mosaic structure of the solid contribute largely to the increase. Impurities that are likely to be present are not of the Raoult type, and do not cause appreciable variations.

Chemical Compositions And Reactions

Pure Hydrocarbons from Petroleum, J. GRISWOLD AND E. E. LUDWIG, *Ind. & Eng. Chem.* **35** (1943) pp. 117-9.

In an attempt to separate the constituents of six-carbon fraction from natural gasoline by fractional distillation, two of the last components to distill were methylcyclopentane and benzene. It was found impossible to obtain pure methylcyclopentane by repeated fractionation in a column having an equivalent of more than sixty theoretical plates. Since these two hydrocarbons boil 9.3° C. apart, which is adequate for separation with such a column, an abnormality was apparent, and it was decided to investigate the vapor-liquid equilibrium of the binary system. The authors present atmospheric vapor-liquid equilibrium data for the system methylcyclopentane-benzene. A minimum-boiling azeotrope exists at approximately 90 mole percent methylcyclopentane. Equilibria of binary systems containing aromatic hydrocarbons are discussed. It is evident that the presence of benzene prevents complete resolution of six-carbon petroleum fractions into their pure components by distillation, and that toluene greatly increases the difficulty of but does not prevent complete resolution of seven-carbon fractions. The data are presented in some detail in tabular

ENGINEERING NOTES ON **GIRBOTOL** GAS PURIFICATION

Six standard Girbotol plant sizes answer many needs

Removes essentially all traces of H_2S as well as the bulk

Factory assembled, compact and easily erected at low cost

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• Standard factory-assembled Girbotol plants offer *low cost purification* for many applications that may not require large, individually engineered plants. These compact, easily-erected standard units are designed in *six sizes.*

The Girbotol Process has proven *the most economical method known* for removing and recovering acid gases, such as hydrogen sulfide and carbon dioxide, from gaseous mixtures and liquid hydrocarbons.

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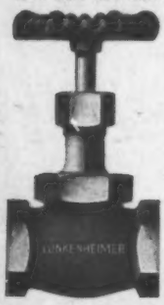

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Illustrated are a few of the many types of Lunkenheimer Valves helping to produce vitally needed equipment for the Army, Navy, Maritime Commission and Air Force and other war agencies.

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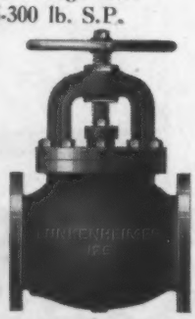

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BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

and graphical form. A bibliography of 22 references is appended.

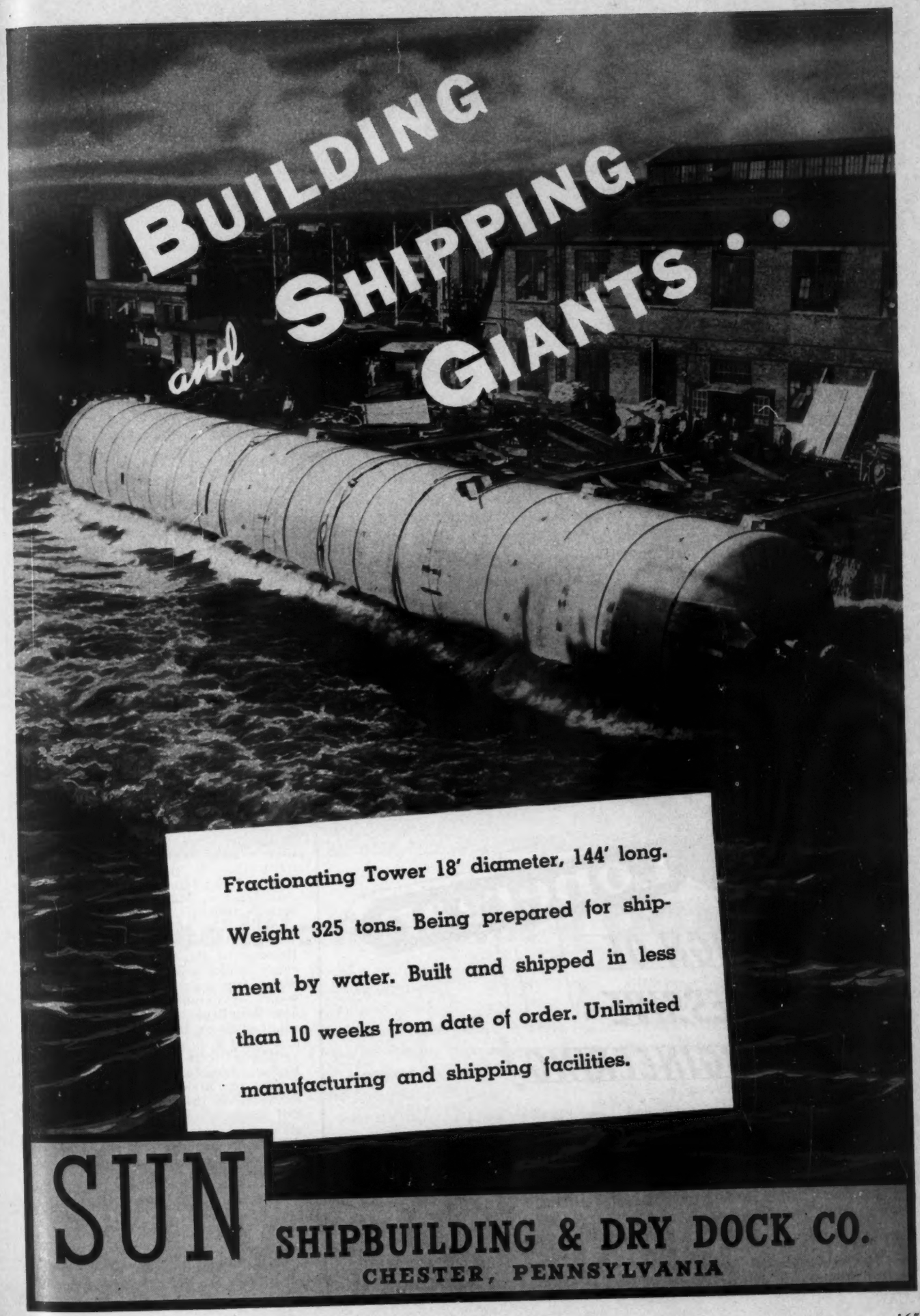
Manufacture of Butadiene from Ethyl Alcohol—II, J. A. GAMMA AND T. INOUYE, *Chem. & Met. Engr.* **50** (1943) pp. 94-7.

In a previous article the authors gave flow sheets and a comprehensive review of published data on the direct conversion process for manufacturing butadiene from ethyl alcohol. In this, the concluding installment, the aldol method is discussed, and the making of butadiene from acetylene, ethylene, acetaldehyde condensation, crotonaldehyde and other processes are considered. Alcohol is oxidized to acetaldehyde, which is condensed to aldol, which is hydrogenated to 1,3-butylene glycol, which substance is dehydrated to butadiene. Another series of reactions is to dehydrate ethyl alcohol to ethylene, which can then be reacted in any one of several ways to produce butadiene. Ethylene can be thermally converted directly to butadiene either by passing a mixture of ethylene and carbon dioxide diluent over a catalyst consisting of ferric oxide and ferric chloride at a temperature of 400° C., or by passing ethylene with nitrogen through a silica-lined chamber under a pressure of one atmosphere and at temperatures from 775 to 885° C. Acetylene is an important starting point in the synthesis of butadiene and has been used, particularly in Germany. Direct conversion of acetylene to butadiene can be made under the action of the zinc chloride at 420-430° C. By the catalytic dehydration of crude aldol in an acid medium at temperatures above 85° C. crotonaldehyde is obtained as the product, with almost quantitative yields. Crotonaldehyde when catalytically hydrogenated yields crotonyl alcohol and butyl alcohol. Conversion of these substances to butadiene is discussed. A bibliography of 42 references is included.

Manufacture: Processes and Plant

Chem. & Met. Report on Labor Relations and Collective Bargaining in Chemical Industry, CHEM. & MET. EDITORIAL STAFF, *Chem. & Met. Engr.* **50** (1943) pp. 99-106.

Unionization on a large scale in the Chemical Industry is a development since 1937, yet probably some 35 to 40 percent of all workers in chemical industries as defined in this report are now covered by affiliated union agreements. However, many executives and plants still have had little or no direct experience with the intricacies of collective bargaining. Yet it is generally agreed that once the war emergency has passed and business turns all its energies toward satisfying hungry civilian markets, the problems of labor relations will rise to plague the industry. Now, not when the storms break, is the time for management, supervisors, and foremen to become familiar with the knotty problems of collective bargaining and to lay the foundations for harmonious labor relations after the war. It is in order to contribute toward this process of self-education for what is to come in the post-war period that this report has been written by the staff of Chemical and Metallurgical Engineer-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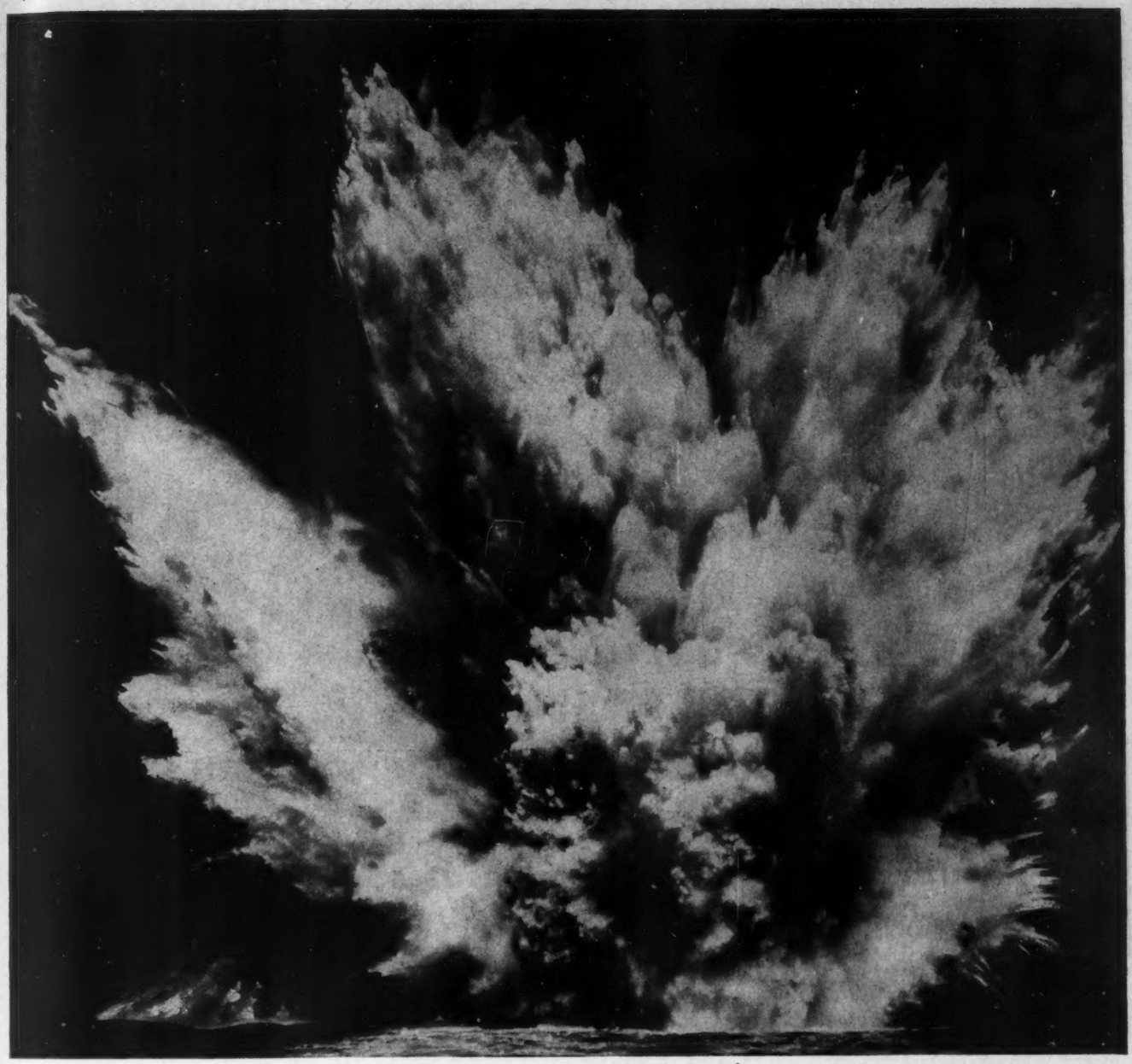
ing. The information contained has been gathered from many sources, chief of which is a recent bulletin No. 716, "Collective Bargaining in the Chemical Industry, May, 1942," of the Bureau of Labor Statistics. Although petroleum refining is one of the least unionized of all of the processing industries, it is believed that the material contained in this article will be of interest and importance to anyone dealing with labor problems. Among the subjects discussed are: union agreements, duration of agreements, union status, activities affecting status, wage agreements, hours and overtime, shifts and overtime, holidays, vacations and leaves, seniority and promotions, lay-offs and promotion, discharge and quits, foremen and apprentices, military service, adjustment of disputes, arbitration, and strikes and lockouts.

First Progress Report from Office of the Rubber Director, CHEM. & MET. ENGR. EDITORIAL STAFF, *Chem. & Met. Engr.* **50** (1943) p. 85.

The total requirements of natural and/or synthetic rubber are estimated at 577,000 and 672,000 long tons for 1943 and 1944 respectively. Domestic inventory stocks cannot be reduced below 120,000 tons at any time. The inventory of rubber in the fall of 1943 will, to all practical purposes, be down to the absolute dangerous inventory dead-line of 120,000 tons, and by the end of 1943 will have been increased to only 175,000 tons. Hence a policy of rigid conservation of rubber must be followed. New plants to provide the desired increase in Neoprene and Thiokol are being started. Currently, the existing copolymerizing plants promise to provide the required capacity in that direction. Shortages of raw material will, however, forbid running these to even rated capacity for another year; hence, no further copolymerizing plants will be started for another six months. Final arrangements have been completed for a portion of the recommended 100,000 tons a year of additional capacity of butadiene from refinery conversions. Shortages have been found in fabricated components (such as instruments, forgings, valves, heat exchangers, etc.), more than in materials. One of the standard copolymerizing plants is to be completed in March. Facilities for the manufacture of a considerable tonnage of Buna S by what is essentially standard plant design are already finished. Because of the shortage of butadiene, every emphasis is being brought to bear on the production of the first increments of butadiene and styrene. The first butadiene will come from the alcohol plant at Institute, West Virginia, and this will be closely followed by butadiene from petroleum at Baton Rouge, Louisiana. A plan has been started to obtain detailed requirements from all of the claimant agencies for end products of rubber or rubber substances to meet actual schedules of production of airplanes, trucks, ships and other products requiring rubber or rubber-like materials.

Saran Pipe and Tubing, DOW CHEMICAL COMPANY, *Chem. Eng. News* **20** (1942) pp. 1508-10.

Saran pipe, made from a chemically resistant thermoplastic resin, is well suited for use in chemical processing plants, and by oil, gas and water com-



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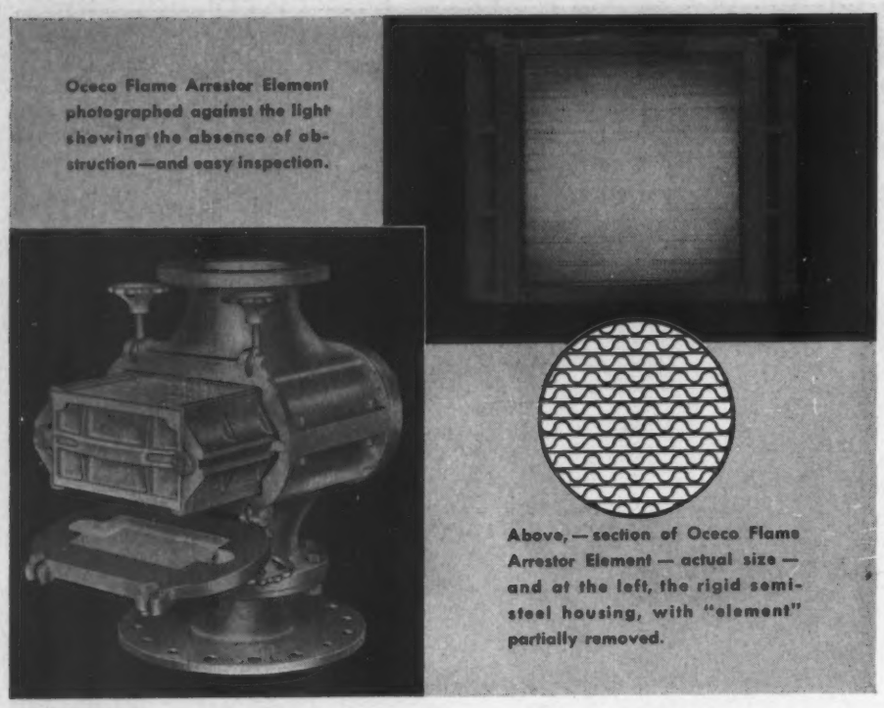

Oceco Flame Arrestor Element photographed against the light showing the absence of obstruction—and easy inspection.

Above,—section of Oceco Flame Arrestor Element—actual size—and at the left, the rigid semi-steel housing, with "element" partially removed.

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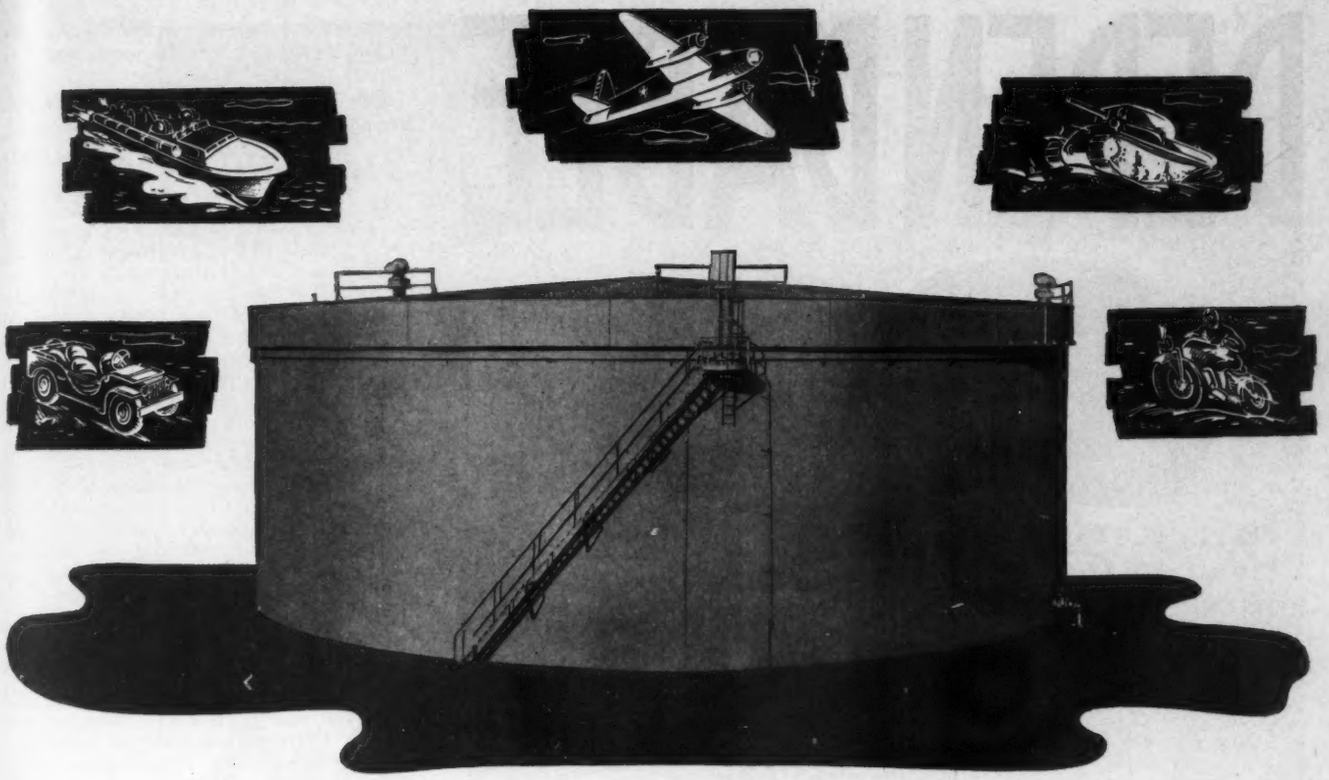
Selection of Pumps for Oleum and Strong Sulphuric Acid, W. E. PRATT, *Chem. & Met. Engr.* **50** (1943) pp. 86-9.

This is the first of several articles dealing with the selection and operation of acid pumps under war-time conditions, when the work of selection on the one hand, and of operation on the other, must often be done by inexperienced persons. The present article is concerned with tank car loading and transfer pumps. An accident is described resulting from a sticking valve. A steel valve had been used because steel piping and tanks could be used satisfactorily. The inexperienced specification writer did not realize, however, that the protective coating of ferrous sulphate that forms on tanks and pipe would be removed on the rubbing surface of the valve. A pump and piping diagram for loading tank cars with strong sulphuric acid is given, and the manipulation of the valves is described in the text so that the pressure on the stuffing box can be made negative while the pump is running, and relieved entirely when it is shut down. Calculation of pressure drop in the lines connecting the pump is discussed and illustrated, and the selection of the proper type and capacity of pump is discussed in some detail. All good acid pumps are so designed that the pressure created by the impeller is not transmitted to the stuffing box. This is accomplished by the use of full open impellers, by suitable balance port holes or by "pump-out" vanes or similar devices on the back of the impeller.

Products: Properties And Utilization

The Nature of Lubricating Oils. R. LINKE, *Kolloid-Z* **97** (1941) pp. 189-92.

The viscosity-temperature curve of a lubricating oil was compared with the curves for nitrobenzene, phenol and their mixtures. From a study of the curves it was concluded that lubricating oils contain associated molecules that dissociate thermally. More than 100 lubricating oils examined had the same type of curve. It is assumed that the lubricating properties of the oil depend upon the association relations; that the oil film is formed by the dissociation products, which by means of residual valence enter into an adsorption compound with the surface to be lubricated. Viewed in the light of this dissociation theory, the influence of high pressure, elevated temperature, impuri-



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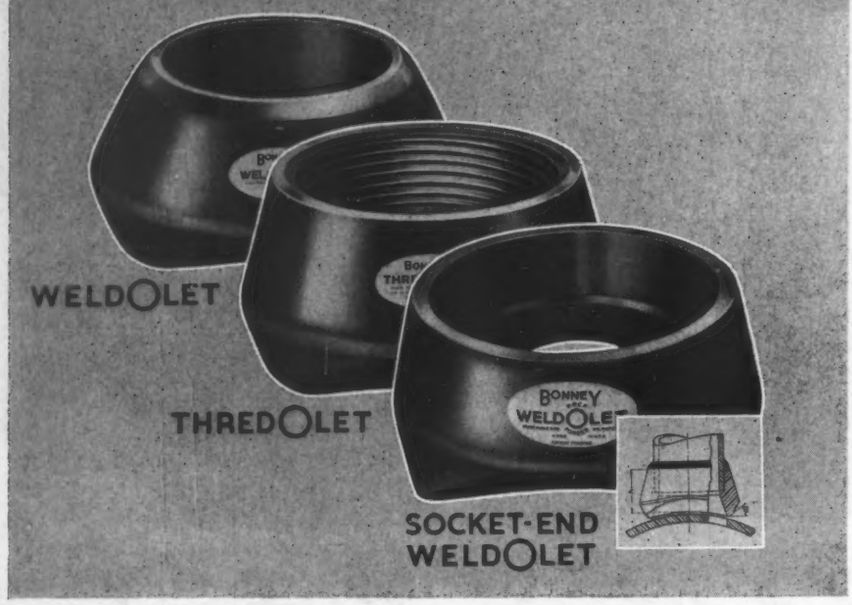

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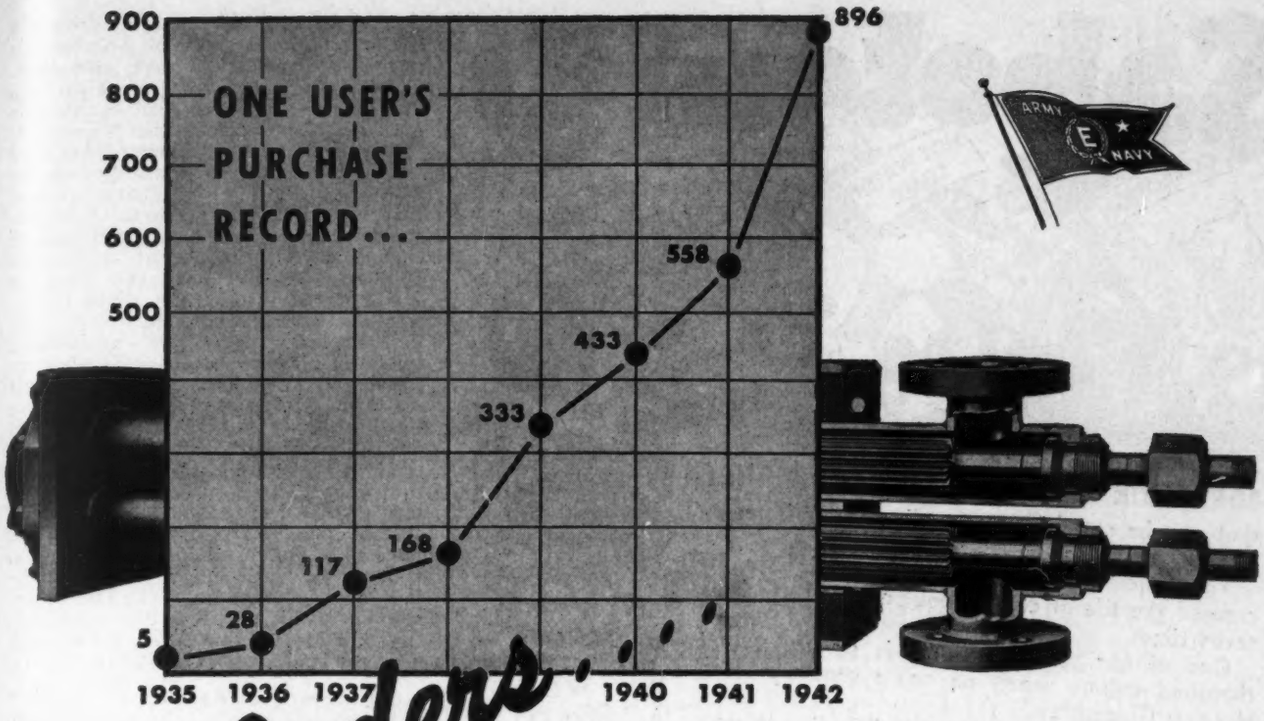
ties and the specific properties of the oil on lubrication can be explained.

The Influence of Temperature on Boundary Lubrication; J. J. FREWING, *Proc. Roy. Soc.* (London) **A181** (1942) pp. 23-42.

The frictional behavior between mild steel surfaces lubricated with excess of pure hydrocarbons, ketones, alcohols, amides, acids and esters has been investigated at low speeds and high loads. Among the hydrocarbons examined were hexadecane, diphenylmethane, paraffin wax, bis-p-diphenylmethane. All these gave smooth sliding in the solid state and a sharply defined transition to stick-slips at the bulk melting point. Lauryl and ceryl alcohols gave smooth sliding in the solid state and transition to stick-slips at the melting point. The same was found to be true for methyl heptadecyl ketone, myristome and benzophenone, and for acetamide, pelargonamide and myristamide. Numerous acods from butyric to stearic were examined, as well as ferric stearate. Comparison is made between stereoisomeric unsaturated acids such as oleic and elaidic. In all cases examined a transition from smooth gliding to irregular stick and slip occurs at a temperature that is characteristic of the particular lubricant employed. Experiments made with films of lubricant one or more molecules thick show that the transition occurs when the adsorbed surface film breaks down and becomes disoriented. Acids and esters are shown to be strongly absorbed while hydrocarbons, ketones, alcohols and amides are not. The strong adsorption occurs by the interaction of the dipoles in the polar group with the metal atoms on the surface. The results suggest that the molecules of long-chain compounds are oriented on a metal surface in the same way as on a liquid surface. Under conditions of boundary lubrication existing at high loads and low speeds excess lubricant is squeezed out and lubrication depends on a unimolecular film on each surface. The variation of friction with the load in the case of oleic acid shows that in this case the orientation extends beyond the primary adsorbed layer. This explains earlier anomalous results and accounts for the good lubricating properties of oleic acid. The effect of white oil on a unimolecular film was studied and the time taken for the oil to dissolve the film was studied. Studies were made of the effect of solutions of lubricants in white oil. The results confirm the hypothesis relating transition with orientation.

Surface-Active Agents, F. D. SNELL, *Ind. & Eng. Chem.* **35** (1943) pp. 107-117.

A surface-active agent is one that modifies the properties of the surface layer of one phase in contact with another. The broadest definition includes all hydrocarbon derivatives. The oldest surface-active agent is soap, whether made by saponification of fats with alkali or in more complex forms by neutralization of fatty acids with amines. Sulfated castor oil is a sulfuric acid ester formed at the hydroxyl groups of glyceryl ricinoleate. Structurally it is a simple step to the sulfuric acid esters of the fatty alcohols, a commercial development made possible by improvements in production methods of the high-molecular-weight alcohols. Addi-



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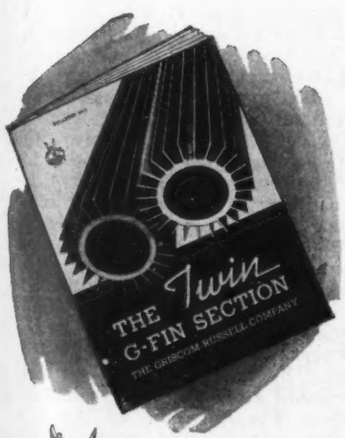

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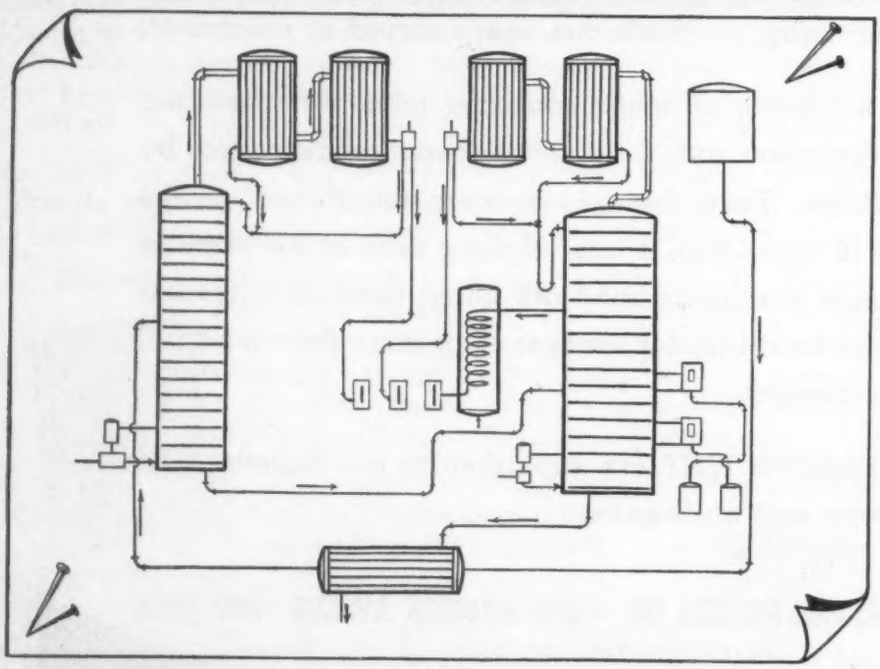

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tion of a hydrocarbon side chain and a sodium sulfonate group to an aromatic nucleus forms alkyl aryl sulfonates. This class of compounds may rival soap in price when produced in comparable quantities. The nucleus used is predominantly that of benzene, but naphthalene and hydrogenated cyclic compounds are also important. Quarternary amines, carrying high-molecular-weight hydrocarbon chains, form a reversed type of surface-active agent. Most types such as those already mentioned have an active anion; this has an active cation. Complex ethers and esters with long hydrocarbon chains are nonionizing types of surface-active agents also applicable in nonaqueous media. The great majority of surface-active agents have —COONa, —OSO_2ONa, or —SO_2ONa as th water-attractive group, and a straight-chain hydrocarbon radical of the range C_8 to C_{18} as the water-repelling group. Related manifestations of surface activity are lowering of surface tension, reduction of interfacial tension, increase of wetting power, emulsification, and deflocculation. The rate of development of surface-active agents in the past decade has been great, each new one leading to many more.

Surface-Active Agents, F. J. VAN ANTWERPEN, *Ind. & Eng. Chem.* **35** (1943) pp. 126-130.

A list of surface-active agents manufactured in American and commercially available is given. This includes about 220 compounds, of which only three are made by petroleum refiners, although many of the raw materials used in the manufacture of the other compounds are from petroleum or its by-products.

A Fractional-Distillation Microapparatus, C. TIEDCKE, *Ind. & Eng. Chem.,* Anal. Ed. **15** (1943) pp. 81-2.

Several excellent working apparatus have been designed during the past 30 years for fractionating macroquantities of liquids under normal and reduced pressures. Microdistilling equipment, however, has not received the same concentrated attention. Much of the dissatisfaction with microdistillations stems from attempts by operators to make quantitatively sharp fractionations with equipment that is obviously limited to qualitative purifications. The limitation of microdistilling equipment to purifications cannot be too strongly emphasized. A new apparatus has been designed in which minimum distance between distilling flask and receiver was secured by using an inside receiver, and which also permitted collection of the arbitrary fractions without interruption of distillation. The apparatus is described in some detail, as well as the method of operation. The efficiency of the apparatus has been tested with many liquids ranging in boiling points from 60 to 300° C. The quality of the material distilled can range from ½ cc. to 5 cc.

Illinois Gasoline Plant Is Being Transferred

Sunflower Natural Gasoline Company is dismantling one of its two natural gasoline plants in the Salem field, Marion County, Illinois, for transfer to the Benton field, Franklin County. George Engle, president of the company, said $250,000 would be spent for new equipment at the Benton plant.

Competing with the enemy

There's a new kind of competition in the oil industry today It isn't a race for more customers — it's a race to serve to the limit the enormous wartime needs of one big, preferred customer — Uncle Sam

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KEYSTONE CARBON COMPANY

Keystone Carbon Company, 3007 State Street, St. Marys, Pennsylvania, has enlarged its production of small parts which are made by moulding from metal powders. Small parts thus made do not need machine finishing. Among them are cams, eccentric parts, levers, rotors, slide blocks.

Some of the advantages of producing parts in this manner are economy of fabrication, conservation of materials, and as a substitute for unavailable material. Tolerances, not possible by ordinary methods, are readily maintained.

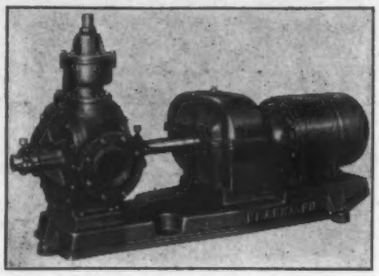
Powder Metal Parts

Moving parts can be pre-lubricated and have improved resistance to wear. This process also permits use of alloys not possible to obtain by other methods, and porosity and specific gravity can be acquired to exact specifications. Shorter tooling time is required and delivery is quicker. Many parts can be produced more economically by this method.

Rotary Pump

BLACKMER PUMP COMPANY

Blackmer Pump Company, Grand Rapids, Michigan, has begun production on a rotary pump with an improved removable liner. This unit operates on thet same swinging vane principle as all other standard Blackmer pumps but it is so constructed than when wear finally



Blackmer Rotary Pump

affects the capacity of a pump, the old liner may be removed, and a new one set in place. The replacement operation involves only the removal of the pump heads, driving out the old liner and inserting a new one. Neither piping nor drive is disturbed, and normally the pump can be back in operation in half an hour. Due to the self-adjusting buckets, no fitting is necessary. This construction represents a definite improvement over present "lined pumps" in that the anchoring mechanism is simplified, the cam bore changed and the intake and discharge ports "streamlined" to handle more viscous liquids and increase the volumetric efficiency of the pump.

The quick replacement feature not only saves the cost and critical materials required for a new pump, but shortens the "down-time". It is especially important for pumps handling corrosive or mildly abrasive liquids, where pump life is normally very short.

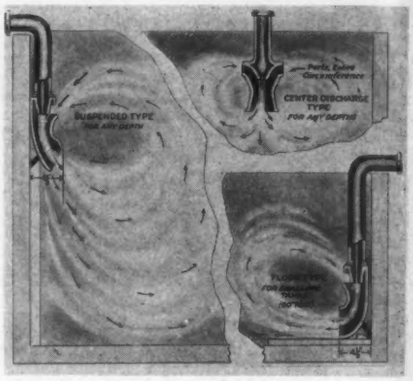
Blackmer pumps with the improved removable liners are being made in capacities from 20 to 750 GPM and pressures up to 300 psi, and are available with reasonable promptness for plants in war production where proper priority rating may be extended.

Steam Jets

DURIRON COMPANY

The Duriron Company, Dayton, Ohio, has designed three new circulating steam jets. In addition to corrosion resistance, the jets are so designed that they fit inside the walls of either square or circular tanks with maximum projection of 4½ inches.

The suspended and center discharge types may be used in tanks of any depth. The floor type is adaptable for tanks of any depth up to 60 inches. All types are so designed as to give complete agi-



Duriron Steam Jet

tation and circulation of the tank contents.

Made of the high-silicon iron alloy Duriron or the special stainless steel Durimet, they are highly efficient for heating acid solutions, dissolving powdered or lump chemicals, and for the separation of sludge acids.

Viscometer

R. P. CARGILLE

R. P. Cargille, 118 Liberty Street, New York, is now offering the Young-McArdle viscometer, which is designed to facilitate determination of viscosities of polymer solutions and other liquids which are so viscous they can not be conveniently tested by other methods.

It provides liquids of certified viscosity sealed in matched glass tubes 4½ x 1 inch with empty, matched tubes for the samples to be tested. Viscosity is determined by inverting the tubes and comparing the rise of an air bubble in the sample with the rise of bubbles in the known standards. The air bubble in the heaviest standard requires about three minutes to rise. The procedure requires no special experience.

Condensate Return Unit

FRED H. SCHAUB ENGINEERING COMPANY

Fred H. Schaub Engineering Company, 307 North Michigan Avenue, Chicago, has designed a new line of condensate-return units, Series G, which conform to War Department chief of engineers specifications. They can be used for a variety of condensation-return requirements.

The units are completely prefabricated, with all interconnecting piping and wiring installed.

Some units are carried in stock for

"A FAIR OFFER

IF YOU WILL PUT A JENKINS VALVE

recommended for your particular service, on the worst place you can find—where you cannot keep other valves tight—and if it is not perfectly tight or it does not hold steam, oil, acids, water or other fluids longer than any other valve, you may return it and your money will be refunded.

. . . JENKINS BROS."

Distributed by

The CORBETT-WALLACE CORPORATION.

Quality Products Plus Engineering Assistance

SAWYER AND WINTER STREETS • HOUSTON • PHONE CAPITOL 5327

Always heat treat after repairs

Information supplied by "Petroleum Refiner"

When refinery vessels have been subjected to welding and cutting in the field, either for repairs, or for the insertion of extra nozzles, they should always be stress relieved before return to service.

Formerly stress relieving involved dismounting the vessel, and transporting it to the nearest furnace capable of accommodating it. Now stress relieving can be accomplished without removing vessels from their foundations.

Stress relieving in the field calls for adequate gas consumption in a specially designed burner, which is located at the base of the vessel. The top openings are converted into a damper system.

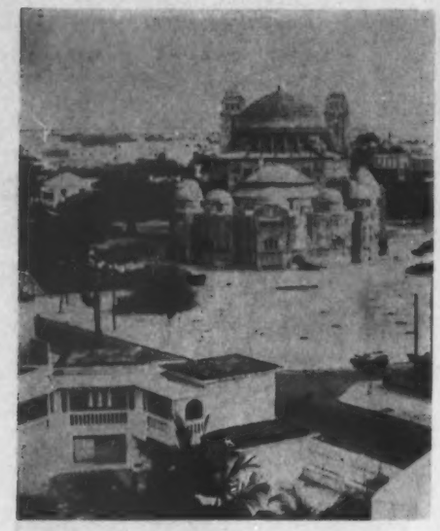
Manipulation of the burner and the damper permits heating the full length of the vessel to the required temperature and holding it at temperature for the proper length of time.

Thermocouples spaced along the vessel provide means for maintaining accurate control of the heat treating operations.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY



DAKAR—WEST AFRICA

400 Miles

South of the Sahara

When our troops swung into Dakar, they found Layne Wells and Pumps on the job, producing millions of gallons of water daily. The Dakar installations had been made under the direction of Layne engineers and are identical with the famous high efficiency, long lasting Layne Wells and Pumps now serving your own local cities and industries.

Layne Wells and Pumps are in use throughout the African War Zone. They were chosen from a field of world wide competitive makes. The reasons for their selection are quite obvious; more skilfully designed, more ruggedly built and more efficient in operation. In war as in peace, their dependability has never faltered.

Tremendous quantities of well water is an absolute war necessity and today hundreds of speedily installed Layne Wells and Pumps are serving aircraft makers, ordnance works, munition factories, chemical plants, ship yards, flying fields, troop training areas and navy yards. Present production is now nearly 100 percent for the war needs, but every effort is being made to keep private and municipal installations in operation.

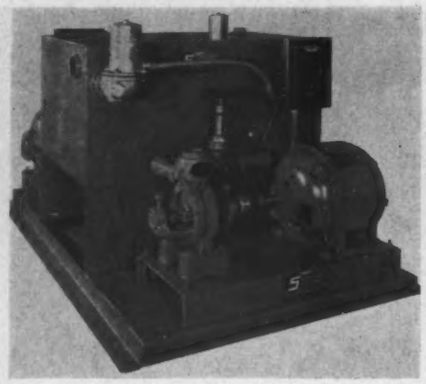
For literature, catalogs, folders, bulletins, etc., address LAYNE & BOWLER, INC., Memphis, Tenn.

LAYNE
PUMPS & WELL WATER SYSTEMS

Affiliated Companies

Layne-Arkansas Company.....Stuttgart, Ark.
Layne-Atlantic Company.....Norfolk, Va.
Layne-Bowler New England Corp....Boston, Mass.
Layne-Central Company.....Memphis, Tenn.
Layne-Northern Company.....Mishawaka, Ind.
Layne-Louisiana Company.....Lake Charles, La.
Louisiana Well Company.....Monroe, La.
Layne-New York Company.....New York City
Layne-Northwest Company.....Milwaukee, Wis.
Layne-Ohio Company.....Columbus, Ohio
Layne-Texas Company.....Houston, Texas.
Layne-Western Company.....Kansas City, Mo.
Layne-Western Co. of Minn.....Minneapolis, Minn.
International Water Supply, Ltd...London, Ont.

WORLD'S LARGEST WATER DEVELOPERS



Schaub Series G

immediate shipment. Most models are available for quick shipment of three to four weeks or less. These systems can be currently purchased on a priority as low as A-1-C.

Bearing Metal

THE COOPER-BESSEMER CORPORATION

The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has announced a process whereby tin content of bearing babbitt can be reduced and anchoring methods eliminated.

"With a large proportion of the world's tin supply under enemy control," said Ralph Boyer, chief engineer of the company, "we believe we have found a most satisfactory alternate for commonly used bearing alloys of high tin content. This will undoubtedly be suitable for all bearings with the possible exception of those subjected to the most severe stresses."

According to research and development engineers of this manufacturer, a comparatively new metal-cleaning method known as the "Kolene" process was credited largely for its success in being able to use and satisfactorily anchor lead-base bearing babbitt.

The process is unique in that it provides an exceptionally firm and uniform bond between lead-base babbitt alloy and the Meehanite metal from which Cooper-Bessemer bearing shells are cast.

Using an engine-driven compressor as an example, T. E. Eagan, chief metallurgist, revealed how the engine's bearing shells and crosshead shoes were cleansed of surface impurities by means of immersion in salt-bath solutions.

The bearing shells are first dipped into a hot molten salt bath to remove the carbon particles common in cast iron. By cleaning out these particles in the metal, a considerable amount of anchoring surface is added for bonding the babbitt.

After rinsing, the backings are placed in another salt bath to reduce surface oxidation resulting from the first bath.

The backings are again rinsed and suspended for a few seconds in cold hydrochloric acid before they are dipped in a flux and placed in a low tin-content alloy which forms a uniform coating on the bearing surface.

The bearing backings, so coated, are placed in proper jigs, and babbitt is poured against them, which readily forms the tight bond necessary to stand the pressure and stresses of big-engine operation.

YOUR ANSWER for speeding wartime MAINTENANCE

Salvaging Valves the FAST Oakite Way!

Because of the prevailing difficulty in obtaining new replacement parts, you cannot afford to discard muck-encrusted valves, fittings, piping or other parts. Nor is there any need to do so! Salvaging these parts the FAST, EASY Oakite way will help make most of them GOOD AS NEW!

Just soak parts in recommended Oakite degreasing solution. You'll find ALL oil, grease and muck have been thoroughly softened and loosened so that deposits are usually "knocked off" with a pressure-rinse. Parts are left in excellent condition for QUICK inspection and EASY repair!

Data FREE on Request

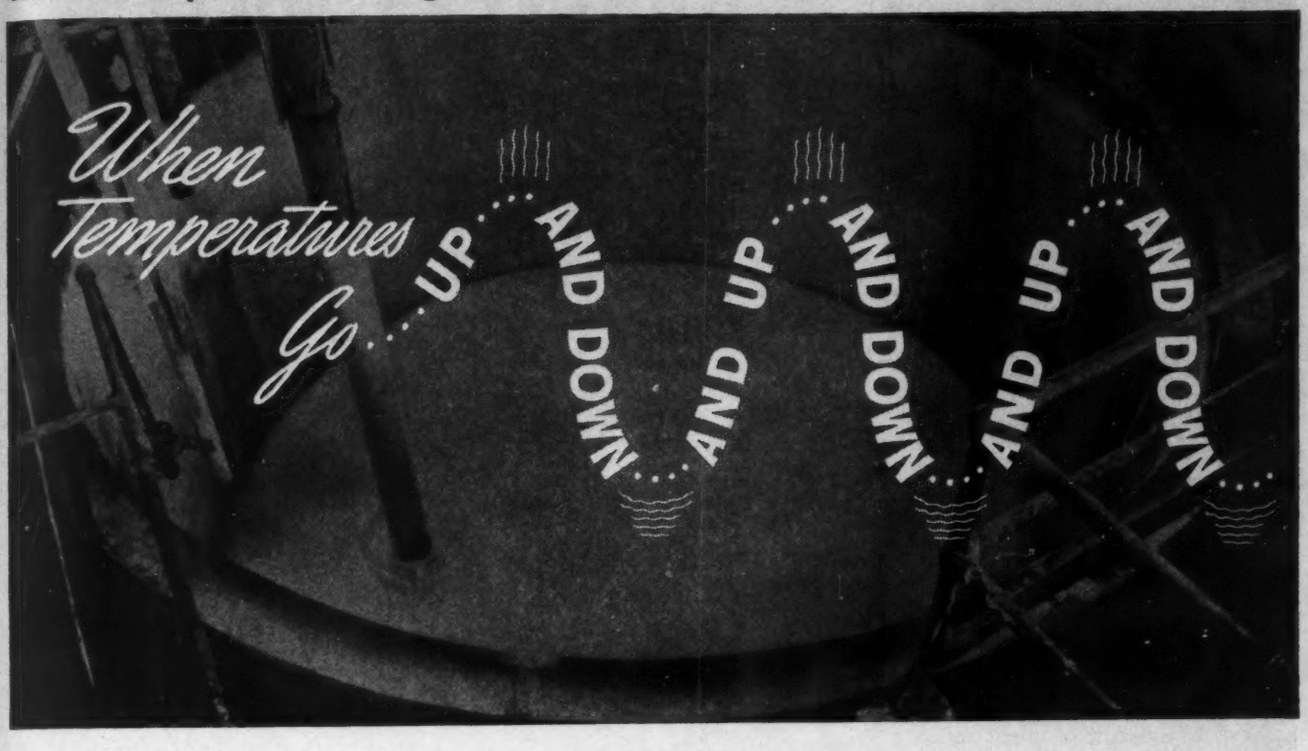
Let us show you how you can save time, conserve effort on this and such other jobs as drum washing, paint stripping and steam cleaning. Write today! No obligation.

OAKITE PRODUCTS, INC.
50B Thames Street, New York
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**

Buy Bonds for Victory

How to Keep Acids Working for Victory . . . . . No. 1



TODAY, acids have a bigger job of work to do than ever before—helping industry turn out munitions, oils, metals, chemicals, fertilizers, textiles in a steady flow.

Shutdowns are critical. Everything possible must be done to prevent the breakdown of acid handling equipment.

* * *

High among causes of shutdowns in many acid processes are the repeated, drastic temperature changes to which tanks used to heat and cool acid solutions are subjected.

The continuous expansion and contraction, with its accompanying movement or working of the lining, is severe service for any material to withstand.

* * *

Tellurium Lead has been found by certain users to perform better than other types of lead under conditions where repeated and abrupt temperature changes occur. It is thought that this may be due, among other things, to Tellurium Lead's *work-hardening* property. As this lead is worked, it is toughened—increased in tensile strength.

The work-hardening property of Tellurium Lead is also a safeguard wherever lead must be bent, stretched or hammered as in elbows, flanges, coils, joints and turnover points.

* * *

Another source of acid equipment trouble is vibration. The resultant dynamic or fatigue stresses, acting in combination with corrosion, are more disastrous than either factor alone.

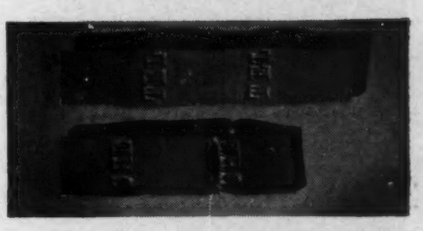
To meet this condition, Tellurium Lead not only has all the acid corrosion resistance for which lead is noted but, under vibration tests, it exhibits a 60% greater endurance limit than lead without the tellurium addition.

* * *

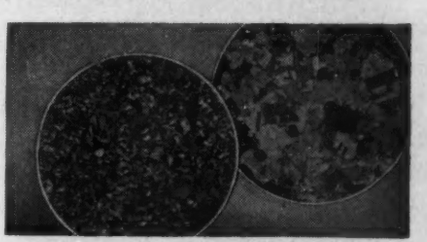
Undoubtedly, another factor in Tellurium Lead's resistance to corrosion under severe conditions of heat and stress is its finer, more uniform grain structure, shown in the accompanying photomicrographs. The surface of Tellurium Lead sheet and pipe is smoother—there is less possibility of pitting and local corrosion.

Tellurium Lead of our manufacture is time-tested St. Joe chemical lead alloyed with a small quantity of tellurium. It is available in sheet or pipe form, or fabricated in coils for heating and cooling purposes.

For further information address the nearest Company branch listed below.



It work-hardens: These strips of Tellurium Lead (top) and regular lead (bottom) were stamped and pulled out in a tensile testing machine. Note how Tellurium Lead was strengthened by the stamping, whereas the other lead was weakened—and fractured.



Note Finer Grain Structure: Photomicrographs of Tellurium Lead (left) and ordinary lead (right), showing the finer, more uniform grain formation brought about by the addition of tellurium. Another significant point: In laboratory tests extruded strips of Tellurium Lead, annealed at 150°C for six months, showed no grain enlargement. Metallurgists agree that freedom from grain growth means less danger of rapid corrosion at elevated temperatures.

USERS "TELL" RESULTS

"We used your Tellurium Lead sheet to line an acid-cutting tank. Strong sulphuric acid is dumped into the tank and sufficient water added to bring it to the proper strength. This naturally generates considerable heat. The operation has been repeated daily for nearly three years. To date no leakage or other difficulty has been experienced. The lining is as good as the day installed."

* * *

"Tellurium Lead sheet was used to replace a tank lining which had been in service about three years. The old lining had bulged to such an extent that it rendered the tank useless. The Tellurium Lead lining has now been in service about two years. No bulging has occurred. The lead still conforms to the tank shape as snugly as it did on installation."

* * *

"We have just checked up on the condition of the 3-year old Tellurium Lead lining in our large sulphuric acid mixing tank. We found the lead to be very smooth and uniform with no signs whatever of buckling although the tank is used for cutting raw acid to low specific gravities. Comparison with other tanks in the same room and used for identical purposes shows that Tellurium Lead makes an ideal lining. The other linings have given us trouble by buckling and cracking open along the welded joints."

TELLURIUM LEAD

NATIONAL LEAD COMPANY—New York, Baltimore, Buffalo, Chicago, Cleveland, Cincinnati, St. Louis, National-Boston Lead Co., Boston; John T. Lewis & Bros. Co., Philadelphia; National Lead & Oil Co. of Penna., Pittsburgh; Georgia Lead Works, Atlanta; American Lead Corp., Indianapolis; Master Metals, Inc., Cleveland; The Canada Metal Co., Ltd., Toronto, Montreal, Winnipeg, Vancouver.

What do you mean...

SELF-LUBRICATING PACKING ?

Palmetto and other Greene Tweed packings contain an extra reservoir of lubricant... not oil-can oil... but a special graphited lubricant which is hot-impregnated into every strand BEFORE braiding. This extra lubricant replaces that lost through wear and keeps Greene Tweed packings soft ... in service longer ... without danger of scored shafts.

Try a Greene Tweed Packing (see list below) ... and you will quickly learn its many benefits. Obtainable from your supply house or, if necessary, from us.

WRITE FOR LITERATURE

GREENE, TWEED & COMPANY

Bronx Blvd. at 238th St., New York, N. Y.

TWISTED

For valve stems; each strand a perfect piece of lubricated packing.

BRAIDED

For rods and shafts; layer over layer construction insures uniformly even bearing surfaces.

PALMETTO

for steam, hot water, air. PALCO for water. PELRO for oils. CUTNO for alkalis. SUPERCUTNO (blue asbestos) for acids. KLERO for foods.

SELF-LUBRICATING **PACKINGS**

☆ BUSINESS NOTES ☆

Smith Is Metallurgist Of Tube Turns, Inc.

Fred C. Smith has been appointed chief metallurgist of Tube Turns, Inc., Louisville, Kentucky. From 1936 until assumption of his new duties he was with Carnegie-Illinois Steel Company, Chicago, as field metallurgist. Previously he was plant metallurgist for International Harvester Company at Fort Wayne and at Chicago.

FRED C. SMITH

He was elected a vice president of the American Society for Metals in 1942, a position he resigned upon coming into the Tube Turns organization. He is a member of the American Society of Automotive Engineers as well as other technical organizations.

In his new position he will have supervision of all raw and finished materials, inspection, forging operations, heat treating as well as metallurgical research and service.

Promotions Made by The Bristol Company

Promotions in the sales and engineering departments of The Bristol Company, Waterbury, Connecticut, have been announced as follows by Howard E. Bristol, president:

L. G. BEAN

L. G. Bean, who has been vice president and general sales manager, is now vice president in charge of engineering and sales;

Harry E. Beane, who has been field sales manager, is now sales manager;

E. L. Stilson, who has been in the field engineering department, is now assistant sales manager.

L. G. Bean joined the company in 1920 as a sales engineer. He had just completed his work at Worcester Polytechnic Institute, which had been interrupted by military service and graduation from the Coast Guard Academy. In 1921 he became district manager at Boston and in 1925 went to Chicago in a similar capacity. In 1930 he returned to headquarters as assistant chief engineer and in 1935 became sales manager, later becoming vice president.

E. L. STILSON

HARRY E. BEANE

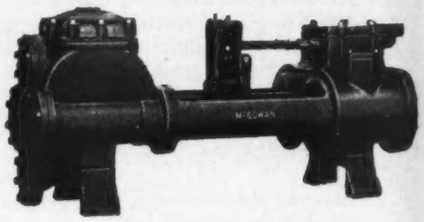
Harry E. Beane, a graduate of Western Kentucky State College, came into the organization in 1920 and five years later became district manager at Birmingham. He went to Pittsburgh in 1930 as district manager where he remained six years before going to headquarters as field sales manager.

E. L. Stilson, a graduate of the University of Washington, also came to the Bristol sales organization in 1920 and spent one year in the Rocky Mountain section and two and a half years on the Pacific Coast. In 1925 he was made resident sales engineer at Cleveland. In 1928 he was put in charge of the Akron service laboratory; in 1931 he was appointed district manager at Birmingham. He was made St. Louis district manager in 1934, and in 1935 he was named manager of The Bristol Company of Canada, Ltd., Toronto. He was made special sales engineer for the petroleum industry in 1938 with headquarters in East Orange, New Jersey, and later moved to Houston. Since 1940 Stilson has been associated with the field engineering department with headquarters at Waterbury.

Prices Reduced on Aluminum Products

Roy A. Hunt, president of Aluminum Company of America, has announced that, as a result of a renegotiation agreement entered into with the government, Alcoa is making effective on March 1, 1943, a new and lower schedule of prices for semi-fabricated and fabricated aluminum. Hunt stated that increased volume

RECIPROCATING PUMPS



Valve Plate as illustrated. 3", 4", 6", 10", 12", 18" strokes. Boiler Feed or Miscellaneous Service. For 250 p.s.i. working pressure.

●

Also manufacturers of these type pumps:

SIMPLEX and DUPLEX
STEAM and
POWER DRIVEN
HORIZONTAL and
VERTICAL
FORGED STEEL, CAST STEEL
BRONZE and Various
ALLOYS
VALVE PLATE, SIDE POT
MISCELLANEOUS DESIGNS

McGOWAN PUMPS

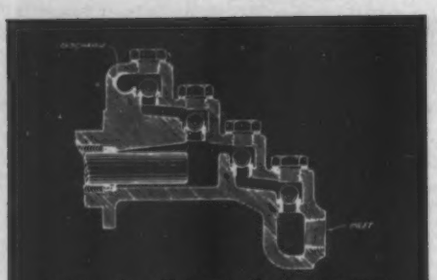
LEYMAN MANUFACTURING CORP.
The JOHN S. McGOWAN Co. DIVISION
59 CENTRAL AVE. CINCINNATI, OHIO

is helping cut production costs for a well known refinery in processing high-grade lube oils.

War's urgent demands require that every heat unit from residues be utilized, to free more petroleum for other vital needs. During the past 30 years, our combustion equipment has helped many leading companies in the Petroleum-Chemical Industries to solve the requirements of new processes. May we bring this experience to *your* service?

NATIONAL AIROIL BURNER
COMPANY, INCORPORATED
1254 East Sedgley Avenue
PHILADELPHIA, PENNA.

We make: Oil Burners, Gas Burners, Gas Pilots, Oil Pump and Heater Sets, Explosion Doors, Access Doors, Air Doors, Burner Blocks, Furnace Observation Windows.



Milton Roy Step-Valve for high pressure service. Non-Clogging. Self-Cleaning. No Air - Binding, No Wire - Drawing. Assures maximum volumetric efficiency in pumping against pressures up to 20,000 lbs. per sq. in.

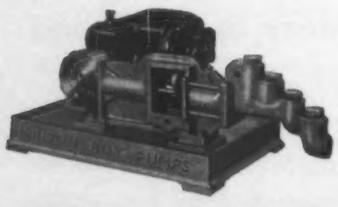
This STEP-VALVE enables MILTON ROY PUMPS

to handle Acid Sludges • Chemicals Intermediates • Solvents • Oils Asphalt • Synthetic Latex • Other Refinery Materials

The secret of Milton Roy Pump efficiency lies in its exclusive Step-Valve design. Note the double-ball checks . . . self-cleaning and non-clogging . . . which make it possible to pump a precise quantity of liquid at every stroke, thus volume may be controlled down to one pint per hour or less. Note that this construction does away with pockets in which air-bubbles might form . . . does away entirely with air-binding and wire-drawing. Thus there is an absolute minimum of slippage, adding further to extreme accuracy in proportioning action.

This valve design is basic, and patented. It is readily varied to meet specific operating conditions. Each valve is engineered for its job. It can be furnished in most corrosion-resistant metals . . . any material that can be cast or forged and machined or machined from the solid.

This valve is the reason why Milton Roy Pumps handle materials that are extremely difficult or impossible to pump by other means . . . as well as processing chemicals . . . in accurately controlled volume.



Our Bulletin 426 explains the Step-Valve in detail, how it functions and why. Write for a copy.

Write, phone or wire, if we can help in your war production.

MILTON Roy PUMPS

1383 E. MERMAID AVE., CHESTNUT HILL, PHILA., PA.

of production together with new and improved technique and equipment have greatly reduced many costs and therefore Alcoa considers as reasonable the requirements in its renegotiation agreement which eliminate those profits which the government felt were excessive and which, unless prices are lowered, would continue to accrue.

Hunt also stated that as illustrated by this new schedule for semi-fabricated and fabricated aluminum and by the four reductions in the price of aluminum ingot, lowering that price from 20 cents in 1939 to its present level of 15 cents a pound, it is the company's policy to pass on to consumers the benefits of its improved manufacturing conditions and research in the form of lower prices and that the company is particularly glad to do so now when the demands of war emergency constitute practically the entire consumption of aluminum.

Mixing Equipment Company Moves New York Office

Mixing Equipment Company, Rochester, New York, has moved its New York office from 377 Broadway to 136 Liberty Street.

The change brought Glenn J. Moorhead, formerly representative at Pittsburgh, to the New York office as Eastern division sales manager. C. F. Donovan will continue as manager at the Liberty Street address.

Klumpp Is Director of American Meter Company

John B. Klumpp, who has been engaged in consulting work since 1929, has been elected a director of American Meter Company. After graduation from Stevens Institute of Technology in 1894 he joined United Gas Improvements Company and remained there in various engineering capacities until 1929.

Fritschel Takes Over Electronic Tube Sales

E. H. Fritschel has been placed in charge of sales of industrial electronic tubes by General Electric Company, Schenectady, New York. He succeeds Dr. H. A. Jones, who is now in military service.

Fritschel, a native of Waverly, Iowa, was graduated from Iowa State College in 1926 with a B.S. degree in electrical engineering. In July of that year he joined General Electric Company as a student engineer. In April of 1927 he went to Uruguay as a construction foreman for the installation of radio transmitting equipment. After returning to the United States eight months later, he again did testing work at Schenectady. He was transferred to the G-E Radio Commercial Department in March, 1929, and has handled radio tube sales for a number of years.

Allegheny Makes Changes In Laboratory Staff

Dr. G. M. Butler, who has been research engineer at the Dunkrik laboratories of Allegheny Ludlum Steel Corporation, has been named chief metallurgist in charge of technical control and research. He is a graduate of Arizona University and of Massachusetts Institute of Technology.

Previous connections were with the United States Bureau of Mines and Climax Molybdenum Company.

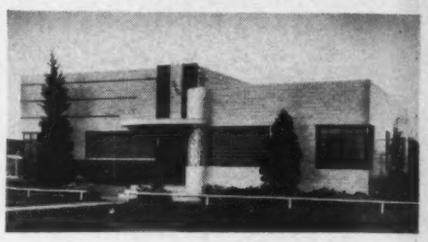
R. T. Eakin has become assistant metallurgist at the Dunkrik plant.

H. K. Porter Company To Build New Plant

Defense Plant Corporation has authorized a contract with H. K. Porter Company, Pittsburgh, to provide equipment for a plant in Pennsylvania at an approximate cost of $100,000. The facilities will be operated by H. K. Porter Company, with title remaining with DPC.

American Locomotive Wins Award for Advertising

American Locomotive Company was given the award for 1942 for "Advertising as a Social Force," at the eighth annual advertising awards dinner in New York February 5. The citation ranked the copy as the best example of advertising "employed educationally,



Refinery Equipment

Valves and Fittings

Pumps and Compressors

Towers and Pressure Vessels

Storage Tanks

Three Complete Topping and Cracking Units for immediate sale.

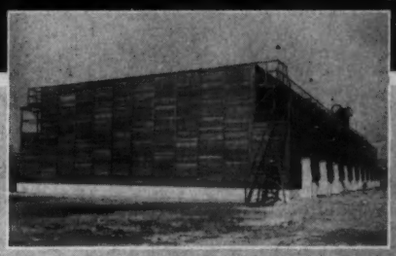
New Catalog Covering Our Complete Stocks Now Available

SONKEN-GALAMBA SUPPLY COMPANY

UNION AVE. AT 21st STREET

TULSA, OKLA.

To Cool The Axis



☆ **COOLING TOWERS** are an important part of the silent service operating behind the lines. The operation of the most perfect mechanical equipment in the world *can only be as good as the auxiliary equipment which serves it.*

The fact that Water Cooling Equipment Corporation Cooling Towers are serving the Air Corps, The Army, The Navy and the great production plants of the country, is ample evidence of their absolute dependability under the most exacting conditions.

WATER COOLING EQUIPMENT CORPORATION

1137 Hereford Road WCEC **St. Louis, Missouri**

When a piece of a flange becomes broken off, a thoroughly practical and permanent repair can be made with SMOOTH-ON No. 1 without the use of heat or dismantling the apparatus.

Paint a thin coat of SMOOTH-ON on both surfaces of the break, and shrink an iron band around the circumference of the flange. If the break is across a bolt hole, an iron washer may provide sufficient reinforcement for the repair.

SMOOTH-ON No. 1 is equally effective for sealing cracks in pump casings, heat exchanger shells, and other pressure vessel castings. Today, when new equipment is hard to get, and production delays cannot be tolerated, SMOOTH-ON is an indispensable necessity in every plant.

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such as for health, political science, national economics, the war effort, etc., or when employed for a product toward bettering the standard of living."

The campaign has dealt with the theme of the possible consequence of a Nazi victory to the American people.

Cooper-Bessemer Has Booklet for Employes

The Cooper - Bessemer Corporation has prepared a booklet, "Partners in Industry," to acquaint new employes with the company and its products. When an employe comes to either the Mt. Vernon, Ohio, or Grove City, Pennsylvania, plant, his booklet is given a personal touch since his name is written below the title.

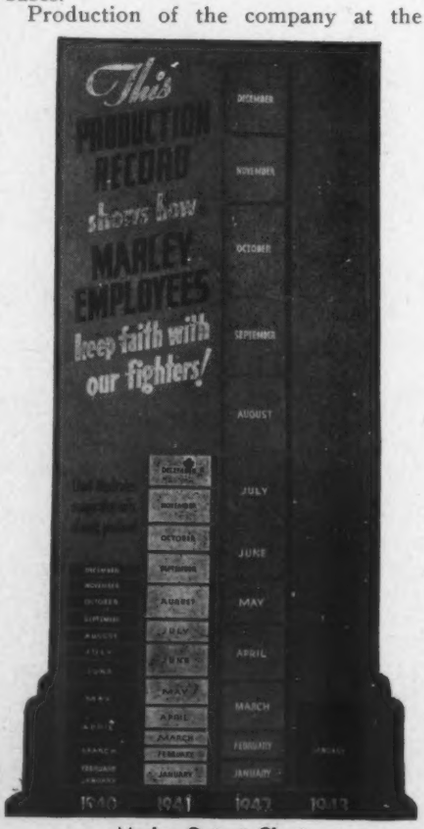
The 44-page booklet presents data which answer many questions that a person not familiar with the company would like to ask.

The foreword explains the purpose of the booklet as follows: "This manual was designed to answer some of these questions and to create a better understanding among all of us who work together to produce some of the best natural gas and diesel engines and compressors made in America today. We ask that you read this manual carefully and do your best to abide by the rules and regulations set forth herein. Your full cooperation will repay you many times over in the personal satisfaction that comes from a job well and faithfully done."

Chart Keeps Marley Employes Informed

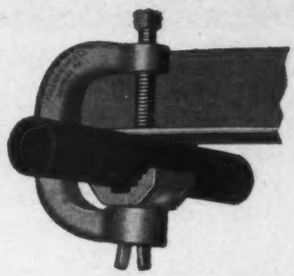
The Marley Company, Kansas City, keeps its personnel informed as to output through a chart in the lobby of the plant. Each month the output record is posted. The plant is producing only for war plants and for Army and Navy bases.

Production of the company at the



Marley Output Chart

Latrobe Products
Floor Boxes - Wiring Specialties



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Sturdy, efficient, economical and adaptable for wide range of work.

Made of high quality malleable iron, electro plated with cup point, case hardened set screw.

The saddle or pipe support turns freely permitting pipe to run parallel to beam or at angles, making installation easy and the use of straps unnecessary.

No. 470 May be used to hang sizes ½ in., ¾ in., and 1 inch to steel beams ⅜ in. thick.

No. 471 for pipe sizes 1¼ in. to 1½ in.

We also make "Bull Dog" Insulator supports and other wiring specialties.

Jobber inquiries invited. Price list and complete information upon request.

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1. Whitlock operates its own boiler and machine shops.
2. Whitlock welders are qualified to make pressure vessels to A.S.M.E. Code requirements, U-68 or U-69.
3. Whitlock X-ray testing equipment available for use when specified.
4. Whitlock can test up to 10,000 lbs. hydrostatic pressure or 4500 lbs. by "air under water" method.

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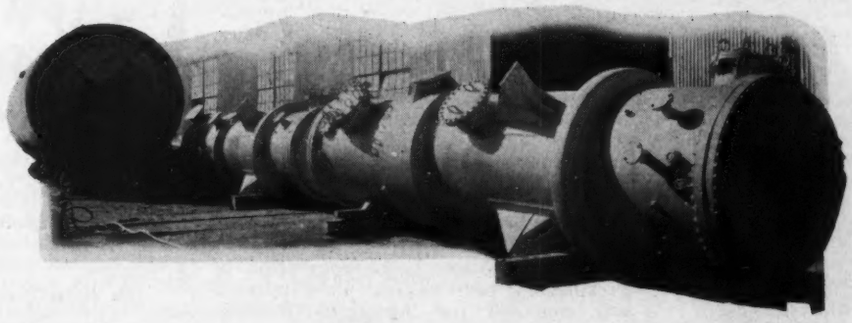

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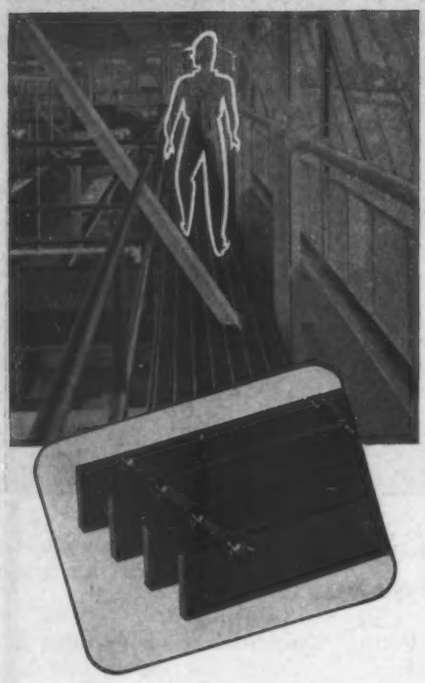

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That BATES fillet weld gives you the full strength of the original steel of main and cross bars, *without dirt-catching overflow of surplus metal around the fillet.* That's important.

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OPEN STEEL FLOORING • STAIR TREADS

beginning of 1943 was triple the production of 1942, which was double that of 1941. Patriotism and determination of the individual workers is credited with the foremost part of this increase since it has been accomplished with but slight increases in equipment and personnel.

Transmission Engineering Has West Coast Office

Transmission Engineering Company has opened a Pacific Coast office at 1151 South Broadway, Los Angeles. M. F. Colgrove, who has been manager of the Bean-Cutler division of Food Machinery Corporation in Los Angeles, has charge of the new office.

He will represent the company in this area for the following firms:

Galland-Henning Manufacturing Company (Baler Division), Milwaukee; Struthers-Wells Corporation, Warren, Pennsylvania; United Iron Works, Oakland, California; Yale & Towne Manufacturing Company (Pump Division), Stamford, Connecticut, and the Chicago Tramrail Company, Chicago.

Promotions Made By Babcock & Wilcox

Leon E. Jenneret, formerly assistant sales manager of The Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania, has been appointed manager of sales of the Welded Tube Division of The Babcock & Wilcox Company, Alliance, Ohio. Edward A. Livingstone, sales manager of The Babcock & Wilcox Tube Company, will serve in a similar capacity of the welded tube division.

William T. Thomas, who has been manager of mechanical tube sales of The Babcock & Wilcox Tube Company, has been appointed assistant sales manager.

F. D. Jones Goes to Copperweld Steel Company

F. D. Jones has been named assistant advertising manager of the Warren, Ohio, division of Copperweld Steel Company. He formerly was advertising manager of Dresser Manufacturing Company and was with the advertising department of Republic Steel Corporation.

Merit Awards Given Manufacturers for War Effort

Army and Navy and Maritime Commission awards of merit have been made to the following companies recently.

The International Nickel Company, Huntington, West Virginia, fourth production award, giving the plant the right to fly the Army-Navy E with three stars. Each star represents the renewal of production honors for a six-month period. Also the plant is privileged to fly the T flag presented by the Treasury Department for war-bond subscriptions.

Elliott Company, Jeanette, Pennsylvania, Army-Navy E in recognition of exceptional performance in supplying war material for America's fighting forces.

The Ohio Injector Company, Wadsworth, Ohio, addition of the white star to the Army-Navy E flag, for high achievement in the production of war goods.

The Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania, the Army and Navy E, for exceptional performance in delivery of materials for the armed forces.

Edwards Valve & Manufacturing Company, East Chicago, Indiana, the Maritime M pennant, for efficiency in building and supplying cast and forged steel valves for the "C" type shipbuilding program.

Mathieson Alkali Works, Niagara Falls, Army-Navy E, for high achievement in the production of chlorine, synthetic ammonia, caustic soda, and other chemicals for the nation's war effort.

Republic to Distribute Wolverine Tubing

Wolverine Tube Division of Calumet and Hecla Consolidated Copper Company, Detroit, has selected Republic Supply Company, Houston, as distributors of its products in the Southwest.

Republic Supply Company, a subsidiary of Republic Steel Corporation, has 36 branches and sales offices in Texas, Oklahoma, Arkansas, Louisiana, New Mexico, Indiana, Illinois and Kansas. The first four states named are those in which it will represent Welvering Tube Division.

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ASPHALT TECHNOLOGIST

Position requires man with technical degree who has had five years experience in the manufacture and blending of roofing and paving asphalts. Location, middle West with medium sized oil company. Our employees know of this advertisement.

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